RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. VIII
Old Series, Vol. XXVII | Chicago | APRIL, 1912 | New York | No. 4

Special Articles in This Issue

Convention Report - - - - American Railway Engineering Association
Convention Report - - - - - - - - - Railway Signal Association
Interlocking at Georges Creek, Md.

FRANKLIN MANUFACTURING CO.

WOOL and COTTON WASTE
"Perfection Journal Box Packing"

85% MAGNESIA LOCOMOTIVE LAGGING.
Asbestos Supplies and Specialties for Railroads
FRANKLIN, PA.

Glidden's Railway Concrete Finishes and Technical Coatings

For Concrete and Steel Construction—Recognized Standards for Quality and Efficiency. Specification Data and Booklet, "The Protection of Iron and Steel," "The Protection, Decoration, Damp-proofing and Waterproofing of Concrete." Sent gratis upon request.

THE GLIDDEN VARNISH COMPANY, Railway Department, CLEVELAND, OHIO

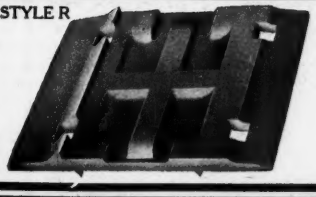
THE MARK of QUALITY — OKONITE — OKONITE WIRES, Cables, Tapes & Cords. ARE STRICTLY ONE GRADE PRODUCTS
CENTRAL ELECTRIC CO. GEN'L WESTERN AGENTS CHICAGO
THE OKONITE CO. EXCLUSIVE MAKERS NEW YORK
SPECIFY OKONITE
ACCEPT NO SUBSTITUTE

THE WEIR FROG COMPANY
CINCINNATI

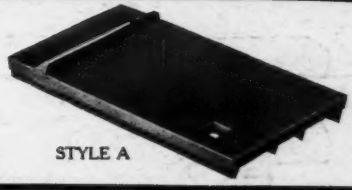
AMERICAN RAILWAY SIGNAL COMPANY
CLEVELAND, OHIO

SEE PAGE 49

STYLE R



TIE PLATES
THE HART STEEL CO.
ELYRIA, OHIO
PLATES ROLLED BY THE ELYRIA IRON & STEEL CO.



STYLE A

HUBBARD TRACK TOOLS
Are the result of many years experience
"Proved Best by Every Test."
Our track chisels are made from the best crucible tool steel that can be produced for this purpose. Every track tool we make is sold under an absolute guarantee. Our track shovels are standard on many roads. Our locomotive scoops are known to every fireman.
HUBBARD & CO.
Write for Catalog PITTSBURGH, PA.

Alphabetical Index to Advertisers, Page 50. Classified Index to Advertisements, Page 4.

This Journal has a larger circulation than any other, in the Maintenance of Way Department of the Railroad

GEO. B. SWIFT COMPANY

(INCORPORATED)

GENERAL CONTRACTORS

AND ENGINEERS

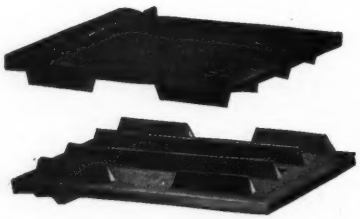
Railroad Structures a Specialty

LONG DISTANCE
PHONE MAIN 639

SECURITY BUILDING
CHICAGO, ILLINOIS

ATLAS RAIL JOINTS, TIE PLATES AND BRACES

ATLAS SWITCH STANDS AND CAR MOVERS



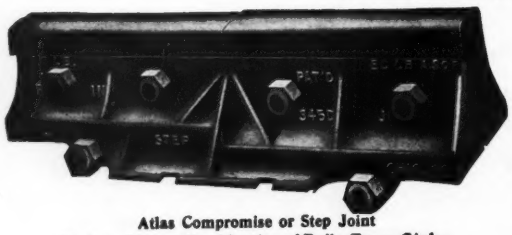
Top and Bottom View of Atlas Tie Plate

Atlas Primer and Surfacer for Your Cars

Atlas Standard Suspended Joint

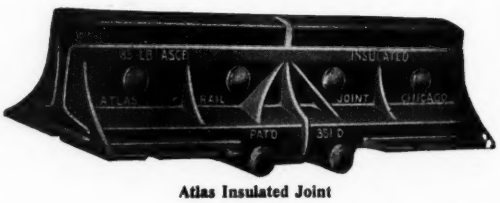
Atlas Compromise and Insulated Joints

Made either of Atlas Special Malleable Iron or of High Grade CAST STEEL.



Atlas Compromise or Step Joint
Made to Fit any Combination of Rails, Tee or Girder.

Made Either Suspended or Supported.

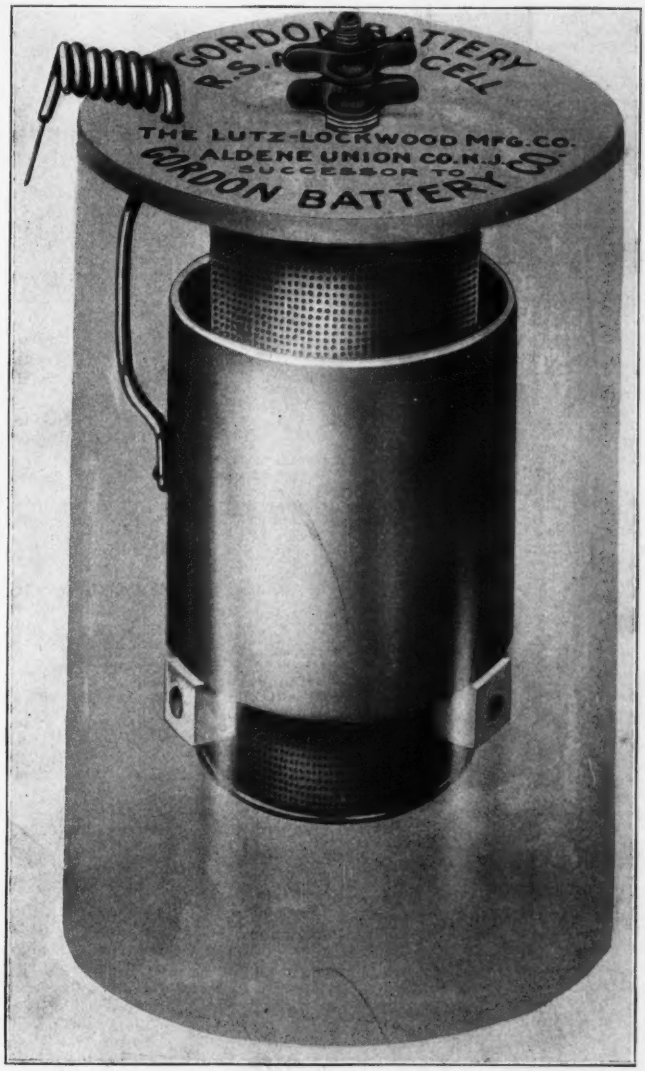


Atlas Insulated Joint

ATLAS RAILWAY SUPPLY COMPANY, 1523-7 Manhattan Building Phone Harrison 2900 CHICAGO

Write for Circular "M"

Gordon Primary Cells



Manufactured and fully guaranteed under the specifications of the Railway Signal Association.

Other sizes and types for other uses such as

Telephone
Train
Despatching

Gas Engine
Ignition

Alarms
Annunciators
Etc.

Investigation as to the merits of the Gordon Cell will prove decidedly interesting.

The

LUTZ-LOCKWOOD MFG. CO.

General Office and Factory,

ALDENE, UNION COUNTY, N. J.

(P. O. Roselle, N. J.)

CHICAGO OFFICE, 1233 PEOPLES GAS BUILDING.

CLASSIFIED INDEX OF ADVERTISERS

Anti Creeper and Tie Plate.
Vaughn Rail Support Co., St. Louis.

Asbestos Products.
Franklin Mfg. Co., Franklin, Pa.

Asbestos Roofing Slates.
Franklin Mfg. Co., Franklin, Pa.

Asbestos Sheathing.
Franklin Mfg. Co., Franklin, Pa.

Automatic Block Signals.
Railroad Supply Co., Chicago.

Axle Washers.
A. Hubbard & Co., Pittsburg, Pa.
H.

Bar
Hubbard & Co., Pittsburg.
Hu

Batt
ry Cells.
Batters Lockwood Co., Aldene, N. J.
Lut
tery Chutes.
BaBryant Zinc Co., Chicago.
ttery Renewals.
BWaterbury Battery Co., Waterbury, Conn.

Battery Supplies.
Bryant Zinc Co., Chicago.
Waterbury Battery Co., Waterbury, Conn.

Batteries, Electric.
Lutz Lockwood Co., Aldene, N. J.
Waterbury Battery Co., Waterbury, Conn.

Belle Isle Motor Cars.
Concrete Form & Engine Co.

Bolts, Nuts and Washers.
Hubbard & Co., Pittsburg.

Books.
Clarke, Myron C., Pub. Co., Chicago.

Bridge Lights.
Gray, Peter & Sons, Boston.

Bridge Paint.
Dixon, Jos., Crucible Co., Jersey City, N. J.
Glidden Varnish Co., Cleveland.
Mamolith Carbon Paint Co., Cincinnati, O.
Moore Mica Paint Co., New York.

Buckets, Automatic Grab.
Brown Hoisting Mach. Co., Cleveland, O.
Williams, G. H., Co., Cleveland, O.

Buckets, Dump.
Brown Hoisting Mach. Co., Cleveland, O.
Williams, G. H. Co., Cleveland, O.

Buckets, Excavating.
Brown Hoisting Mach. Co., Cleveland, O.
Williams, G. H., Co., Cleveland, O.

Builders.
Swift, Geo. B., Co., Chicago.

Building Felts and Papers.
Franklin Mfg. Co., Franklin, Pa.

Bumping Posts.
Mechanical Mfg. Co., Chicago.

Burners, Lamp and Lantern.
Gray, Peter & Sons, Boston, Mass.

Cables.
Central Electric Co., Chicago.

Car Movers.
Atlas Railway Supply Co., Chicago.

Car Replacers.
Johnson Wrecking Frog Co., Cleveland, O.

Carbon Paints.
Mamolith Carbon Paint Co., Cincinnati, O.

Carrier Base for Pipe Lines.
Bryant Zinc Co., Chicago.

Chisels.
Hubbard & Co., Pittsburg, Pa.

Coal Miners' Tools.
Hubbard & Co., Pittsburg, Pa.

Concrete Post Molds.
Vaughn Rail Support Co., St. Louis.

Concrete Mixers.
Marsh Co., Chicago.

Conduit, Wooden.
Michigan Pipe Co., Bay City, Mich.

Continuous Joints.
Atlas Supply Co., Chicago.
Rail Joint Co., New York.

Contractors.
Swift, Geo. B., Co., Chicago.

Cranes.
Nichols, Geo. P., & Bros., Chicago.

Crayons.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Crossing Signs.
Bryant Zinc Co., Chicago.

Crossings (See Frogs and Crossings).

Culvert Pipe, Concrete.
Marsh Co., Chicago.

Derails.
Indianapolis Switch & Frog Co., Springfield, O.

Dump Wagons.
Marsh, Geo., Co., Chicago.

Electric Batteries.
Lutz Lockwood Co., Aldene, N. J.
Waterbury Battery Co., Waterbury, Conn.

Electric Lights for Signal Lamps.
Gray, Peter & Sons, Boston, Mass.

Engineering Instruments.
Seelig, R., & Son, Chicago.

Engineers.
Swift, Geo. B., Co., Chicago.

Forms, Collapsible.
Concrete Form & Engine Co., Detroit, Mich.

Frogs and Crossings.
Cincinnati Frog & Switch Co., Cincinnati.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Gasoline Cars.
Chicago Pneumatic Tool Co., Chicago.
Concrete Form & Engine Co.
Fairmont Machine Co., Fairmont, Minn.
Mudge, Burton W. & Co., Chicago.

Gasoline Engines.
Concrete Form & Engine Co., Detroit, Mich.
Fairmont Machine Co., Fairmont, Minn.

Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Hoes.
Hubbard & Co., Pittsburg, Pa.

Hoisting Machinery.
Brown Hoisting Machinery Co., Cleveland.

Inspection Cars.
Light Inspection Car Co., Hagerstown, Ind.
Mudge, Burton W. & Co., Chicago.

Instruments (Engineering).
Seelig R., & Sons, Chicago.

Insulation and Insulating Material.
Central Electric Co., Chicago.

Lamps and Lanterns.
Gray, Peter, & Sons (Inc.), Boston.

Line Material.
Electric Ry. & Equip. Co., Cincinnati, O.

Lock Nuts.
Boss Nut Co., Chicago.
Interlocking Nut & Bolt Co., Pittsburg.
Verona Tool Works, Verona, Pa.

Locomotive Cranes.
Brown Hoisting Machinery Co., Cleveland.

Locomotive Replacers.
Johnson Wrecking Frog Co., Cleveland, O.

Lubricants, Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Lubrication, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Maintenance of Way Supplies.
Hubbard & Co., Pittsburg.

Manganese Frogs and Crossings.
Cincinnati Frog & Switch Co., Cincinnati, O.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati, O.

Mast Arms.
Electric Ry. Equip. Co., Cincinnati.

Metal Protecting Paints.
Glidden Varnish Co., Cleveland.
Mamolith Carbon Paint Co., Cincinnati, O.
Moore Mica Paint Co., New York.

Mining Instruments.
R. Seelig & Son, Chicago.

Molds, Pipe and Culvert.
Concrete Form & Engine Co., Detroit, Mich.

Molds, Concrete Fence Posts.
Vaughn Rail Support Co., St. Louis.

Motor Cars.
Concrete Form & Engine Co.
Mudge, Burton W. & Co., Chicago.

Nut Locks.
Boss Nut Co., Chicago.
Interlocking Nut & Bolt Co., Pittsburg.
Verona Tool Works, Verona, Pa.

Oil Cans.
Gray, Peter & Sons, Boston, Mass.

Oil Storage Systems.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Oil Tanks.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Works, E. Chicago, Ind.

Paints.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Glidden Varnish Co., Cleveland, O.
Mamolith Carbon Paint Co., Cincinnati, O.
Moore Mica Paint Co., New York.
Pendleton & Co., Stapleton (S. I.), N. Y.

Pencils.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Perforated Metal.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Picks.
Hubbard & Co., Pittsburg, Pa.

Pipe Line Carrier Bases.
Bryant Zinc Co., Chicago.
W. K. Kenly Co., Chicago.

Pipe, Wooden Water.
Michigan Pipe Co., Bay City, Mich.

Plate. (See Tie Plates.)

Pole Line Material.
Electric Ry. Equip. Co., Cincinnati.
Hubbard & Co., Pittsburg, Pa.

Poles, Steel.
Electric Ry. Equip. Co., Cincinnati.

Post Hole Diggers.
Hubbard & Co., Pittsburg, Pa.

Publications.
Clarke, Myron C., Pub. Co., Chicago.

Pumps, Oil.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Rail Braces.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati, O.
Indianapolis Switch & Frog Co., Springfield, O.
Weir Frog Co., Cincinnati.

Rail Drills.
Indianapolis Switch & Frog Co., Springfield, O.

Rail Joints.
Atlas Railway Supply Co., Chicago.
Rail Joint Co., New York City.
Weir Frog Co., Cincinnati, O.

Rail Supports.
Vaughn Rail Support Co., St. Louis.

Railway Equipment and Supplies.
Atlas Railway Supply Co., Chicago.
Bryant Zinc Co., Chicago.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Industrial Supply & Equipment Co., Philadelphia.
Mudge, Burton W. & Co., Chicago.
Rail Joint Co., New York.
Railroad Supply Co., Chicago.
Ramapo Iron Works, Hillburn, N. Y.
Verona Tool Works, Pittsburg.
Weir Frog Co., Cincinnati.

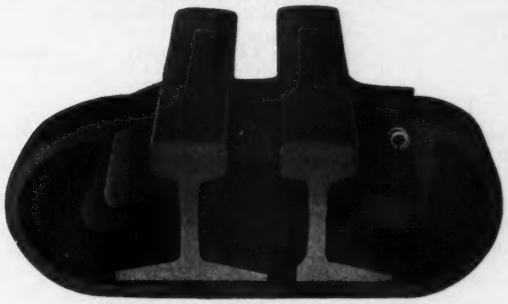
THE WEIR FROG COMPANY

FROGS, SWITCHES, CROSSINGS

OF RAIL OR MANGANESE

Solid Manganese Frog.

We Guarantee to Protect Purchasers from All Liability Due to Infringement of Patents



Adjustable Guard Rail Clamp. Patented.

Switch Stand with Adjustable Throw. Patented.

CINCINNATI, O.

VERONA TOOL WORKS

The Original Manufacturers of Spring Nut Locks in America.

All kinds of Track Tools.

Total sales approximately three quarters of a billion.

Tools with above Trade Mark are always right.

Send for free Blue Print Book. It is of value.

AGENTS { Alex. Macpherson & Son, Montreal
McMullin & Eyre, San Francisco, Cal.
Henry R. Merton & Co., Ltd., 2 Metal Exchange Bldg., London, E. C., Eng.

MAIN OFFICE: Oliver Building, Pittsburgh, Pa.
CHICAGO OFFICE: 40 South Clinton Street.

FACTORY: VERONA, PA.

PITTSBURGH DISTRICT

CLASSIFIED INDEX—Continued.

Replacers, Car and Engine.
Johnson Wrecking Frog. Co., Cleveland, O.

Retorts, Timber Preserving Plant.
Wm. Graver Tank Works, E. Chicago, Ind.

Roofing Materials, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Roundhouse Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Screw Spikes.
Hart Steel Co., Elyria, O.

Sheathing, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Sheet Metal.
Gray, Peter & Sons, Boston.

Shingles, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Shovel Handles.
Wyoming Shovel Wks., Wyoming, Pa.

Shovels, Spades and Scoops.
Hubbard & Co., Pittsburg, Pa.
Wyoming Shovel Wks., Wyoming, Pa.

Signal Lamps.
Gray, Peter & Sons, Boston.

Signals and Signal Supplies.
Bryant Zinc Co., Chicago.
Weir Frog Co., Cincinnati.

Smoke Jacks, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Spikes.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.

Steam and Hot Water Pipe Insulation.
Michigan Pipe Co., Bay City, Mich.

Steel Forms.
Concrete Form & Engine Co., Detroit, Mich.

Steel Plate Work.
Wm. Graver Tank Works, E. Chicago, Ind.

Stone Crushers.
Marsh Co., Chicago.

Striking Hammers.
Hubbard & Co., Pittsburg, Pa.

Surveying Instruments.
Seelig, R., & Son, Chicago.

Switch Lanterns.
Gray, Peter, & Sons, Boston.

Switch Rods.
Weir Frog Co., Cincinnati, O.
Ramapo Iron Works, Hillburn, N. Y.

Switches and Switch Stands.
American Valve & Meter Co., Cincinnati, O.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Switchpoint Adjusters.
Weir Frog Co., Cincinnati.

Tank Cars.
Wm. Graver Tank Works, E. Chicago, Ind.

Tanks and Tank Fixtures.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Works, E. Chicago, Ind.

Telegraph & Telephone Supplies.
Central Electric Co., Chicago.
Hubbard & Co., Pittsburg.

Tie Plates.
Atlas Railway Supply Co., Chicago.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.
Sellers Mfg. Co., Chicago.

Timber Preserving Plant Machinery.
Wm. Graver Tank Works, E. Chicago, Ind.

Track Jacks (See Jacks).

Track Layers.
Hurley Track Laying Machine Co., Chicago.

Track Materials.
Atlas Railway Supply Co., Chicago.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Spencer Otis Co., Chicago.
Ramapo Iron Works, Hillburn, N. Y.
Sellers Mfg. Co., Chicago.
Weir Frog Co., Cincinnati.

Track Tools.
Hubbard & Co., Pittsburg, Pa.
Verona Tool Works, Verona, Pa.
Wyoming Shovel Works, Wyoming, Pa.

Transfer Tables.
Nichols, Geo. P., & Bro., Chicago.

Trolley Brackets.
Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

Turntables.
Nichols, Geo. P., & Bro., Chicago.
Philadelphia Turntable Co., Philadelphia.

Valve Grease, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Varnishes and Japans.
Glidden Varnish Co., Cleveland, O.

Washers.
Hubbard & Co., Pittsburg, Pa.

Water Coolers.
Gray, Peter & Sons, Boston.

Water Filters.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.

Water Softeners.
American Water System Co., Pittsburgh, Pa.
Booth, L. M. Co., Chicago.
Wm. Graver Tank Works, E. Chicago, Ind.
Geo. W. Lord Co., Pittsburgh, Pa.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.

Wedges.
Hubbard & Co., Pittsburg, Pa.

Wire Carriers.
W. K. Kenly Co., Chicago.

Wires.
Central Electric Co., Chicago.

Wire Tapes and Cords.
Central Electric Co., Chicago.

Wooden Water Pipe and Conduit.
Michigan Pipe Co., Bay City, Mich.

Wrecking Frogs.
Johnson Wrecking Frog Co., Cleveland, O.

Wrenches.
Coes Wrench Co., Worcester, Mass.

THE MILBURN LIGHT

FOR

Night Wrecking and Construction

COMBINES

Efficiency and Economy

15,000 Candle Power **6 cents per Hour**

TRY IT AT OUR EXPENSE SEND FOR CATALOGUE

The Alexander F. Milburn Co. 505 WEST LOMBARD STREET BALTIMORE, MD.

BOOTH WATER SOFTENER

Clean Boilers — No wasted fuel — Ask for free Booklet

L. M. Booth Co., 130 Liberty Street, New York

Indestructible Paints

Used satisfactorily by several roads—
The kind you will eventually use.

Moore Mica Paint Company

76 William Street New York City

Spring Frogs
Rigid Frogs
Crossings

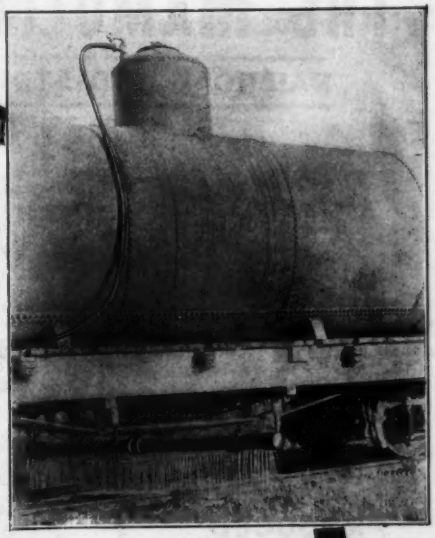
CINCINNATI FROG & SWITCH COMPANY

CINCINNATI, O.

Split Switches
Switch Stands
Rail Braces

How to Kill Track Weeds

There never has been any question about the desirability of keeping tracks, switches and yards free from vegetation. This has been accomplished year after year by mechanical weeding or burning. The first method is expensive, temporary in effect and requires constant attention during the growing season. It disturbs the ballast causing loosened soil, which produces dust and washes readily.



Weed burning does not have even as permanent an effect as mechanical weeding. The results are in no way perfect. Weeds are in fact stimulated by the temporary stunting, and the vegetable ash acts as a fertilizer.

The danger to surrounding property and right of way is also a drawback to the burning method.

Atlas "A" Weed and grass killer affords the best known method of keeping tracks, yards and switches free from vegetation. It is a highly concentrated chemical liquid, which is to be diluted with water and sprayed on the track. It has accumulative effect. It kills the most tenacious growth, top, root and seed. The results are more permanent and complete than any known method of "top plant" destruction. The number and strength of applications necessary in the first year vary with the character of soil vegetation, and length of the growing season.

In addition to killing weeds, Atlas "A" has a most beneficial effect on rails, ties and roadbed.

For more complete data, fill out the coupon and mail it to New York.

Atlas-A Weed Killer

Atlas Preservative Company
of America
95 LIBERTY ST., NEW YORK

FILL OUT THIS COUPON AND MAIL IT TODAY

The Atlas Preservative Company of America
95 Liberty Street, New York

Please send me full particulars about Atlas "A" Weed Killer as applied to use on track_____ ft. wide, vegetation growing_____ months per year.

*Name*_____

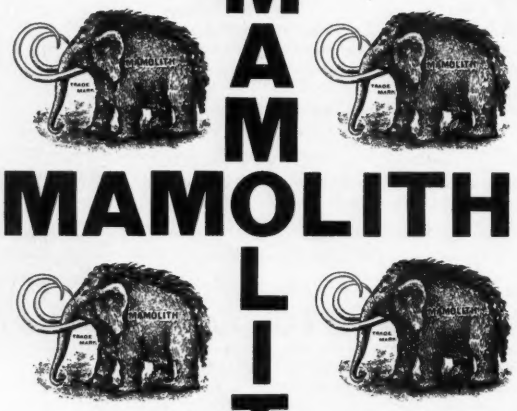
*Railroad and Office*_____

*Address*_____

THE MAMOLITH CARBON PAINT CO.

RAILROAD AND STRUCTURAL STEEL PAINT SPECIALISTS

THE BEST NON-CORROSIVE PAINT EVER PRODUCED



THE PRESERVATIVE PAINT OF UNEQUALLED DURABILITY

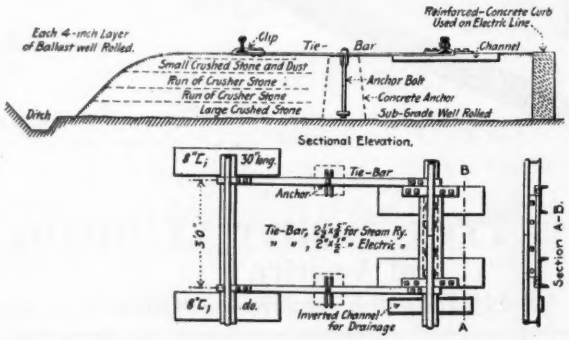
CARBON WORKS, Oakley, O.
PAINT WORKS, Cincinnati, O.

THE SIGN OF STRENGTH

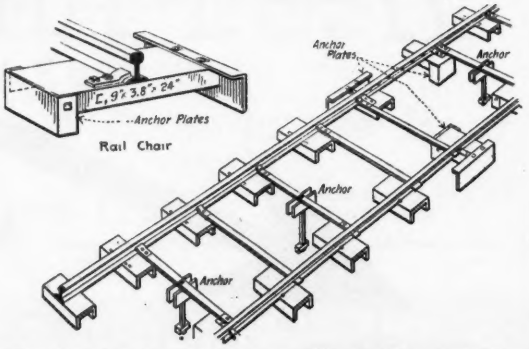
A. B. BURTIS
President and Gen. Mgr.

COFFMAN'S PERMANENT WAY

PATENTED



Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

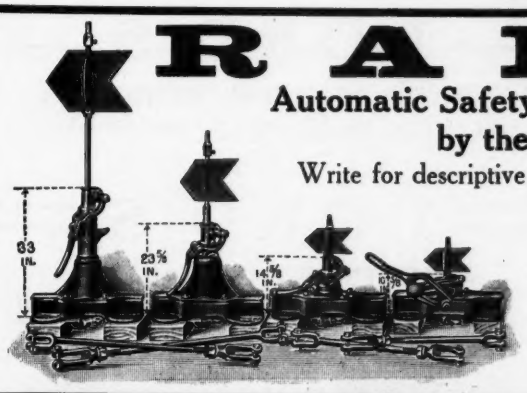
A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

CHICAGO OFFICE
SPACE 50 12th floor Karpen Building
900 MICHIGAN BOULEVARD
Telephone Harr. 1147

W. H. COFFMAN, Inventor

BLUEFIELD, W. VA.

RAMAPO



Automatic Safety Switch Stands Are Manufactured Only by the RAMAPO IRON WORKS

Write for descriptive catalogues on **Switch Stands, Switches, Frogs, Guard Rail Clamps, Etc.**

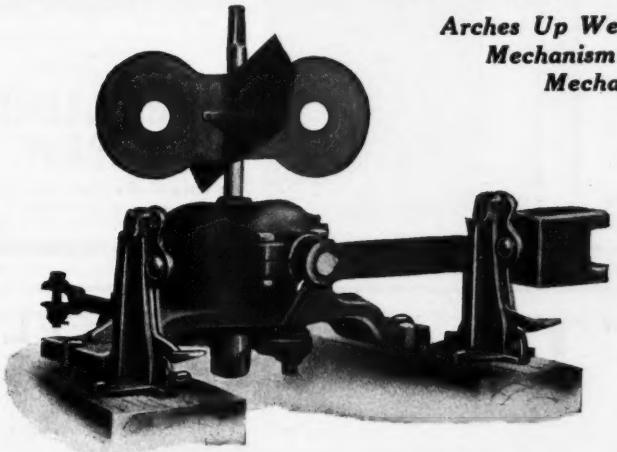
Manganese Track Work a Specialty

RAMAPO IRON WORKS

Main Office: Hillburn, N. Y.
Works: Hillburn, N. Y., and Niagara Falls, N. Y.

REDUCE MAINTENANCE OF YARD SWITCHES

Anderson's Economy Switch Stand



Arches Up Well Above Ties, Keeping Operating Mechanism Free from Snow, Ice and Dirt. Mechanism is Perfectly Housed

A special three way crank is furnished for yard switches, giving you the first three run-throughs without additional cost. Because the crank is so designed that when the switch is run through, one of the cranks will sheer off without any other damage to the switch or switch stand. The switch can be quickly placed in order by connecting the rod to one of the other cranks. Additional three way cranks are furnished at 50 cents each for repairs making the maximum damage to a switch when run through 16 2-3 cents. This feature is not new. Over 30,000 stands with this special three way crank now in use on various roads.

Non-Breakable Cranks are Furnished With All Orders Unless the Special Three-Way Crank is Specified

Full Details and Description of This Switch Stand in Our Catalogue. Write for It

MANUFACTURED EXCLUSIVELY BY

THE AMERICAN VALVE AND METER COMPANY

CINCINNATI, OHIO

NON-CORROSIVE

wooden water pipe is manufactured by The Michigan Pipe Co.

The pipe is steel banded, as shown. The steel bands are protected by a coat of imperishable asphaltum cement. The pipe is strong as steel with the resiliency of wood.

Some advantages of "Michigan Wood and Steel Pipe:

Will not corrode. — Protects water from freezing. — Less friction than metal pipe. — Withstands vibration without loosening the joints. — Withstands water hammer without bursting. — Withstands Hydraulic Pressure of 200 lbs. per sq. inch.

Many other advantages explained in our catalogue—write for it.

This pipe **lasts indefinitely,** and can be made as **strong as desired.**

THE MICHIGAN PIPE CO., Bay City, Michigan

The Johnson Car Replacer

Range and Capacities of the different types are as follows:

	If Not Over	Capacity.	Throat Opening	Wt. Each
Type M for rail 12 - 45 lbs.	3½ inches high	20 Ton Locomotive	2 ins.	30
Type C for rail up to 65 lbs.	4½ inches high	30 Ton Locomotive	2½ ins.	60
Type B for rail up to 80 lbs.	5 inches high	50 Ton Locomotive	3½ ins.	110
Type A for rail up to 100 lbs.	5½ inches high	80 Ton Locomotive	3½ ins.	145
Type Z for rail up to 100 lbs.	6 inches high	100 Ton Locomotive	3½ ins.	165

The Johnson Wrecking Frog Company
CLEVELAND, OHIO

The Most Economical Paint in the Market.

You Specify Your Requirements

INDIAN BRAND OIL AND PAINTS

We Guarantee Our Product

Trade Mark—Copyright Applied For.

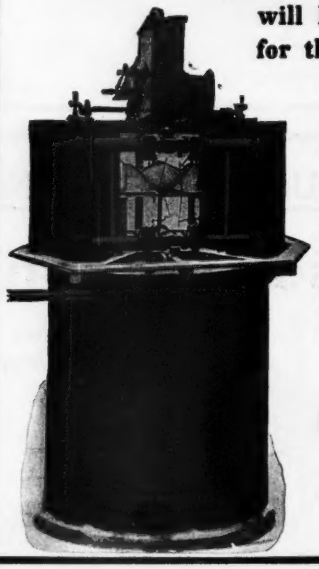
Pendleton & Co. - Front & Thompson Sts. Stapleton, (S. I.) N. Y.

LORD'S

WATER PURIFYING CHEMICALS have been the STANDARD for almost 50 YEARS

LORD'S

WATER PURIFYING APPARATUS will be the STANDARD for the next 50 YEARS



Designed to meet the high efficiency standards of modern railroad management.

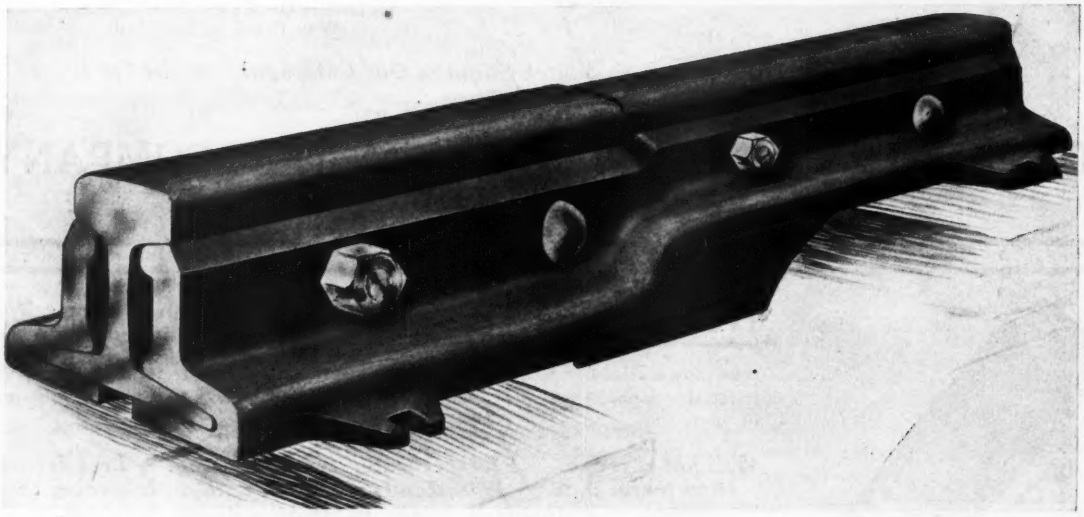
It embodies, in improved form, every worth-while feature found in the best of other makes, besides containing several exclusive features that are predicted by those who have investigated its merits, to make it the leader in its field.

Estimates cheerfully furnished

GEO. W. LORD COMPANY

Philadelphia San Francisco
Agencies in all Principal Cities

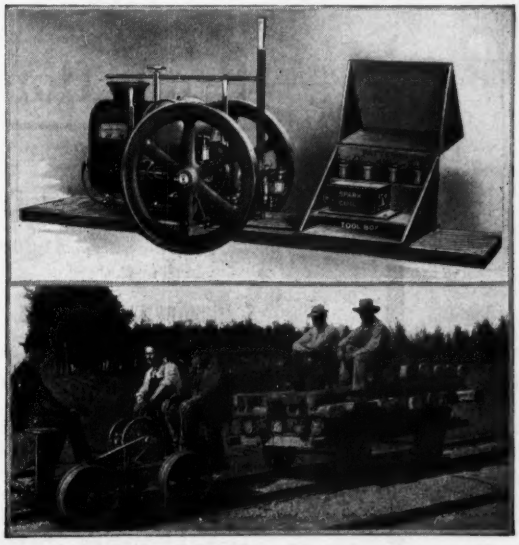
MANHATTAN CAST STEEL STEP JOINT



In Successful Use on Over 50,000 Miles of Track

MANHATTAN RAILWAY SUPPLY CO.
2 Rector Street, New York
Branch Offices: Philadelphia, Pa., Chicago, Ill., St. Louis, Mo.

Fairmont Gasoline Engine for Handcars



REVERSIBLE—Runs Equally Well Either Way Without Turning Car.
SLIDING BASE—Do Not Push Your Car to Start It but Slide Your Engine Back Into the Belt.
FULLY EQUIPPED ENGINE—Can be placed on an ordinary handcar in two or three hours.
GREAT POWER — LIGHT WEIGHT

Get Our Catalogue and Prices.

Fairmont Machine Co., Fairmont, Minn.

COES

KEY MODEL EngineRoom AND Construction WRENCHES

4 SIZES:

28, 36, 48 and 72" long

Write for full information

Coes Wrench Co.

WORCESTER, MASS., U. S. A.

Don't Pump— Buy an Adams

"The Motor Car that's Easy to Buy"

Our time payment plan makes it so and will surely interest you if you do not want to pay cash. Please consider the following facts:

(1) Repairs on the Adams Motor Car are seldom required.

(2) It will run in all kinds of weather and in any climate.

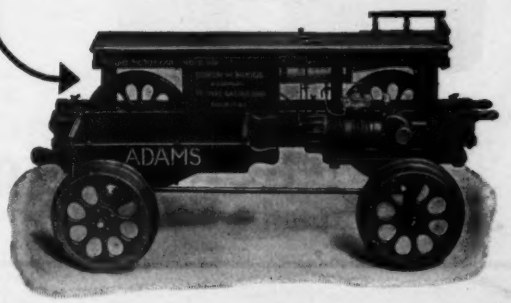
(3) The price is within reach of all.

(4) The railroads are declaring the Adams Car an economical proposition, due to these and many other reasons.

Now, what is the conclusion? Why, this: the Adams Car is the car *you* want. *Write to-day for latest descriptive circular, also cash and time payment forms.*

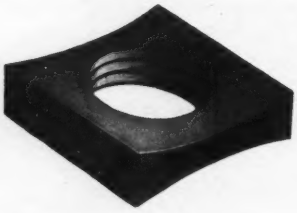
Burton W. Mudge & Co.

1019 Michigan *and* Adams
CHICAGO



Simple *Efficient* *Economical*

Three Reasons Why The

BOSS  NUT

is attracting the attention and favorable comment of Railroad Men everywhere.

May we not have the privilege of showing YOU the many advantages and tremendous locking power of the **Boss Nut?**

A Post Card Request Will Bring Samples

BOSS NUT COMPANY

CHICAGO
Commercial National Bank Building

NEW YORK
2040 Grand Central Terminal

ST. LOUIS
Adreon Manufacturing Company

The Protection

given by your

Highway Crossing Signals

will be greatly increased by the adoption of our

Illuminating Devices

rendering your signs now in service visible at night. They are operated by the bell battery.

We manufacture a full line of track and signal supplies. Send for our catalogue No. 16-E.

BRYANT ZINC COMPANY

Chicago **St. Paul** **New York**
Montreal **Winnipeg**

Signals for Electric Railways

The NACHOD AUTOMATIC SIGNAL for single track gives an indication to the motorman that the block is clear, tells him when he has set the stop signal at the other end, shows to following cars that the block is occupied, and gives each an indication that it is protected in entering; in the meanwhile holding stop signals against opposing cars. It will do this for cars at 55 miles per hour, and gets along on a surprisingly low up-keep.

NACHOD SIGNALS never sleep nor relax their vigilance. They are ever on the alert to prevent accidents. They will protect your curves, increase the capacity of your single track, will give facing or rear protection.

NACHOD SIGNALS are easy to install, require no tearing up of track nor rebonding, and use no insulated rail joints.

Remember

Nachod Spells Safety

Send for circular, or ask for our representative

Nachod Signal Company

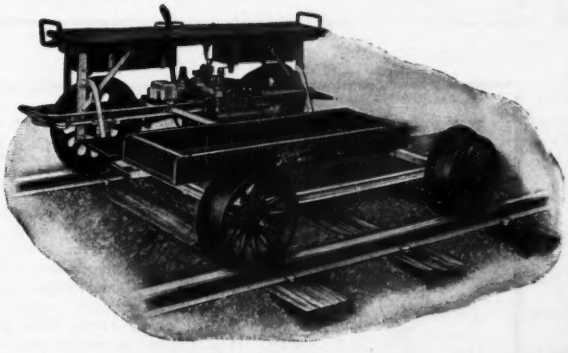
Jewelers Building **Philadelphia, Pa.**

How's The Weather?

It Doesn't Matter If You Have a "Rockford" Magneto Car

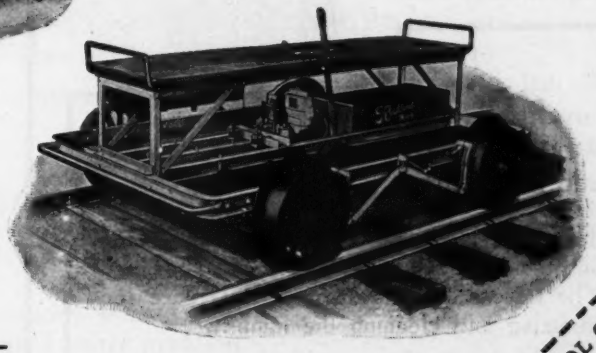
The Car For All Weathers and Temperatures

MAGNETO IGNITION eliminates drycells, spark coil and timer.
WELDED STEEL CHANNEL FRAME preserves alignment of crank shaft and prevents strains on engine.
ROCKFORD ENGINE insures maximum efficiency with minimum fuel consumption and minimum wear and tear.
ROCKFORD CONTROL is simple and dependable.



No. 2 Signal and Inspection Car

Easy to Handle
Easy to Operate
Easy to Pay For



No. 4 Railway Section Car

Capacity, Eight Men and Tools; Cam Shaft, Direct Driven by Spiral Gears, Enclosed and Running in Oil.

Here Is A Sample Of Many We Have On File

"The car I am running now, I received May 3rd, 1910, and up to the present time I have run 3,204 miles without a breakdown or delay of any kind. Have used no repairs since I received this car. I do not think this car can be beat, and I think the Motor Car a great success."

Chicago Pneumatic Tool Company

Chicago Branches Everywhere New York

Factory, Chicago Heights, Ill.

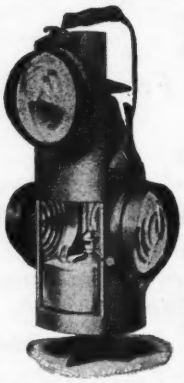
Railroad Dept. CHICAGO PNEUMATIC TOOL CO.
I am interested in your Rockford Cars. Please send catalogue, prices and terms to.....
.....
.....
Also send me Booklet 103 and let me see the Rockford Car GO BY.

RE4

If it is New or Second Hand Equipment You Want, Car Pushers, Rail Benders, Pyrometers or Specialties
Write to THE INDUSTRIAL SUPPLY & EQUIPMENT CO.
407 Sansom Street PHILADELPHIA, PA.

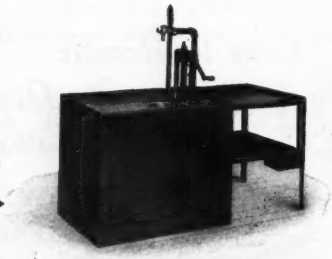
Nichols Transfer Tables—Turntable Tractors
GEO. P. NICHOLS & BRO. - - - - - - - 1090 OLD COLONY BUILDING, CHICAGO

R. Seelig & Son
Manufacturers of
Engineering and Surveying Instruments
Instruments Carefully Repaired and Adjusted
Send for Catalogue
227 N. Fifth Ave. CHICAGO


Round Body Steel Switch Lantern

LANTERNS
SWITCH, ENGINE, SIGNAL, SEMAPHORE, MARKER, STATION, Etc.
CHIMNEYLESS BURNERS
for one day and long-burning service
30 YEARS' EXPERIENCE
New and specially equipped factory enables us to fill large orders promptly and at fair prices.
Illustrated catalogues on request.
PETER GRAY & SONS, Inc.
Mail Address: "Cambridge", BOSTON, MASS.
Chicago Office: 303 Great Northern Bldg.
JOSEPH M. BROWN, Representative.

Bowser Table Tank for Way Stations



It just fits the conditions at way stations or oil houses for cleaning and filling signal lamps.

The pump measures the oil into the lamp and the table catches any dirt or spilled oil. The table serves also as an ideal place for trimming and cleaning the lamps.

This is but one unit of the

Bowser Storage Systems

which covers the entire oil storage field. Get our illustrated book No. 40. Free.

S.F. Bowser & Co., Inc.,
Ft. Wayne, Ind.

Wyoming Shovels
Save Their Cost Many Times

You know what it is to have a lot of shovels, that ought to be in the hands of your laborers, out being sharpened. You know what it is to put a gang of men on a job and wonder why they don't remove as many cubic yards of dirt as you think they should. It is because the shovels they are using don't hold their sharp edge.

It is no exaggeration to say that if you put

Wyoming Shovels

into the hands of the laborers you employ, they will remove more dirt in a given time than they have ever done before. That instead of being out of commission half of the time WYOMING SHOVELS will be "on the job," ready for business.

WYOMING SHOVELS really save their cost because with less men you can get more work.

We have an interesting booklet on shovel construction which you ought to read. Let us send it to you.

WYOMING SHOVEL WORKS
WYOMING, PA.

Get the Most Out of Your Locomotives

BY installing water softening plants at a portion of their water stations the Florida East Coast Railway increased their locomotive mileage from 30,000 miles to more than 50,000 miles between shoppings for boiler troubles. Mileage per ton of coal was increased from 20.2 miles to 20.5 miles allowing a saving of 1565 tons of coal per year. In one year the average freight train haul was increased from 14.7 cars to 20.5 cars while the fuel cost dropped from .1818 cents to .1570 cents per mile with no change in price of coal. In one shop the force of boiler makers on repair work necessitated by water conditions, was reduced from twelve men to four men and all overtime work, which had previously been very heavy, was entirely eliminated making a saving of more than $10,000 per annum in labor for boiler repairs alone.

¶ Our Water Softeners are used by the Florida East Coast Railway and today, with twice as many plants installed as when the above report was made up, are undoubtedly showing even greater economical results.

¶ Results similar to the above are being secured by other railway users of our Water Softeners and you that have corrupt water supplies should be equally benefited.

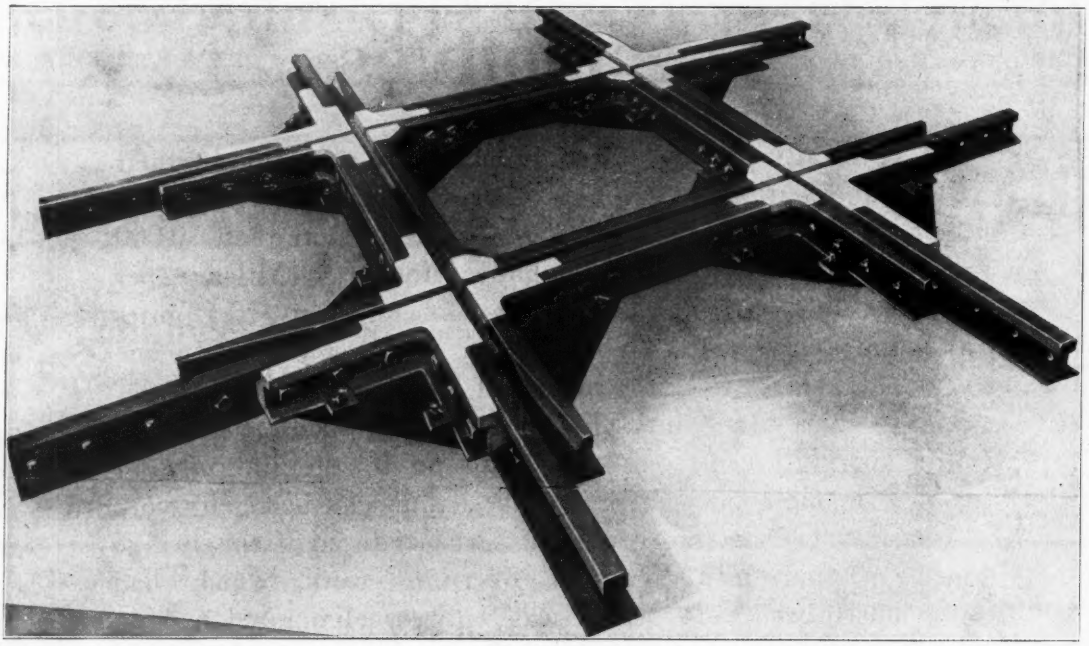
Give us an opportunity to confer with you on *your* hard water problem

American Water Softener Co.

1015 Chestnut Street :-: Philadelphia, Pa.

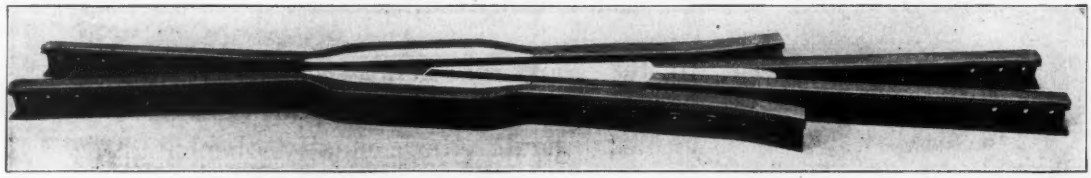
"A Laborer Can Operate The American."

Manganese Insert Crossing



Showing construction with base plates. This design is three rail construction.

MANGANESE HARD CENTER FROG



WING rail pieces, throat point and heel blocks are one manganese casting. The entire wearing surface of this frog is so completely protected with manganese steel that it is especially adapted for use under the most severe traffic. The manganese insert extends beyond the binds of the wing rails in the throat of the frog.

The Frog, Switch and Manufacturing Co.
CARLISLE, PA.

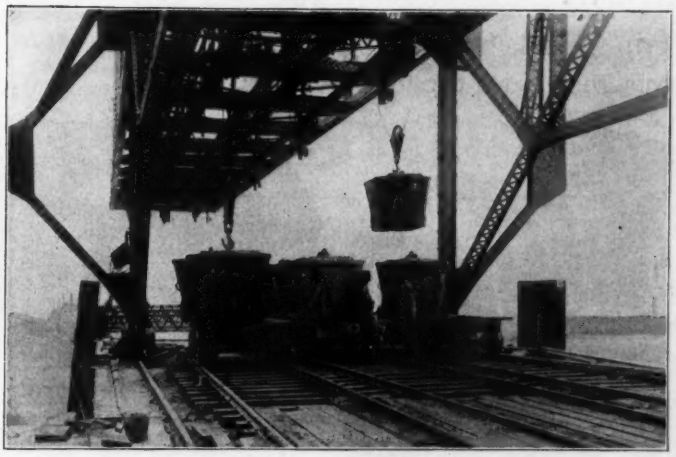
1-24-40-10

That was the way they ordered the 75

DOUD ACME CENTER DUMP BUCKETS

used on this job

These Buckets were ordered after a thorough competitive trial with the other leading makes of Buckets on the market

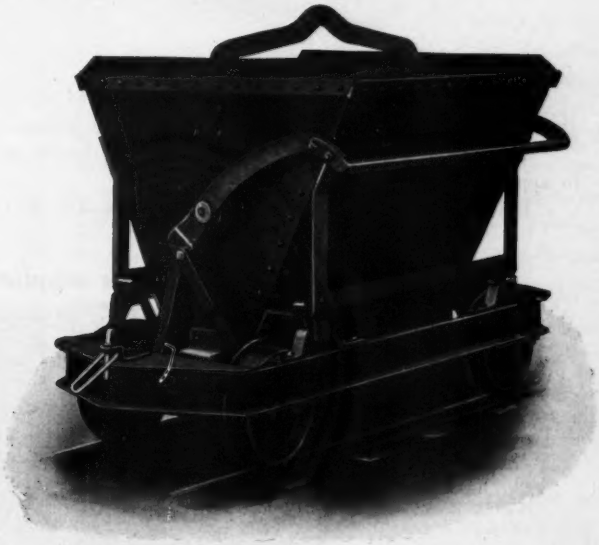


What stronger evidence of superior quality could be asked for?

The Hydro Electric Development, Keokuk, Ia.

Doud's "Acme" Center Dump Bucket Gates Open

(Patented Apr. 5th, 1910)



Doud's Combination Bucket and Car Controllable Discharge

"Acme" Buckets are extremely simple in construction, swift and sure in operation and efficient in results; no clog or splash. We also make a perfect controllable center-discharge bucket, and combination bucket and car.

Write us for Catalog covering the Acme Line Elevators, Cars, Spreader Carts, Etc.

Acme Equipment & Engineering Co.

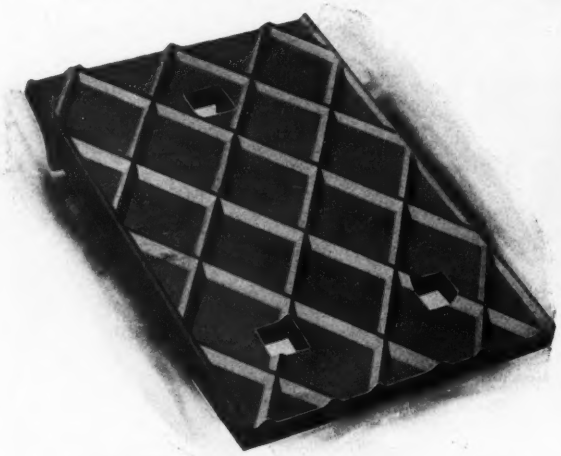
931 Garfield Bldg., CLEVELAND, OHIO

SELLING AGENTS: Barron & Cole Co., New York City; Bunting-Stone Hardware Co., Kansas City, Mo.; James C. Campbell & Co., 1st National Bank Bldg., Chicago; C. A. Cleaver, Houston, Texas; Chas. F. Beebe Co., Portland, Ore.

Sellers Anchor Bottom Tie Plate

THE corrugations on the bottom compress and engage the top fibres of the tie but *do not cut them* as will flanges and claws on other plates. Water and foreign substances therefore do not enter into, rot and destroy the wood.

A firm grip is taken on the tie and track is *held to gauge* on the sharpest of curves and under the most severe conditions.



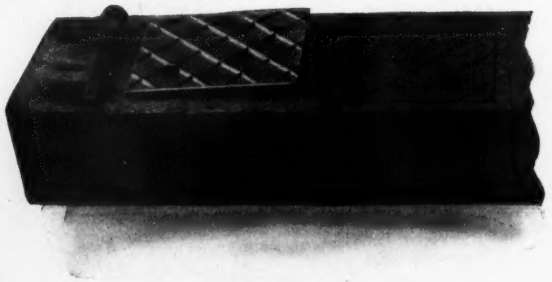


Plate and tie (white oak) in track on main line 5° curve under heavy traffic for four years.
Impressions on the tie show that plate *has not moved* from its original seat.
Both plate and tie are in *perfect condition.*

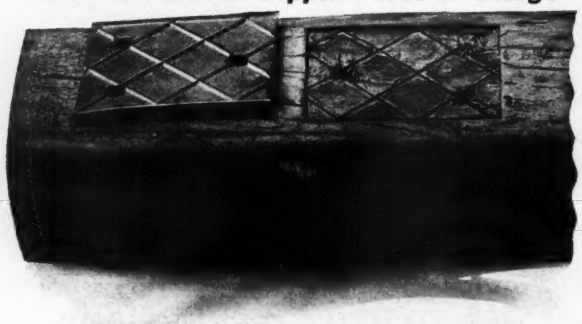
"SELLERS TIE PLATES are rolled at Chicago for Western delivery, from *New 600 lb. Wrought Iron Billets,* and at Pittsburg for Eastern delivery, from new steel *Bessemer* or *Open Hearth Billets."*

The simple construction of this tie plate makes it the easiest and therefore the ***most economical plate*** to apply to either old or new ties.

Plates are made in various sizes and punched with two, three or four holes to fit any section rail.

Trial lots will be supplied free of charge

In Use On **200** Railways



Over **100,000,000 SELLERS TIE PLATES** in Track

Plate and tie (cedar) in track on main line 4° curve under heavy iron ore traffic for *ten and one-half years.*
Plate has not moved from its original seat and *has protected tie* perfectly.

Write for our booklet

SELLERS MANUFACTURING COMPANY
McCORMICK BUILDING
CHICAGO

RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED
ROADMASTER AND FOREMAN

BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK

Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.

CHAS. S. MYERS, Vice-Pres.
C. C. ZIMMERMAN, Bus. Mgr.
J. M. CROWE, Mgr. Central Dist.

LYNDON F. WILSON, Managing Editor
KENNETH L. VAN AUKEN, B.S.C.E., Assoc. Ed.
OWEN W. MIDDLETON, B.S.M.E., Assoc. Ed.

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: 403 House Bldg., Pittsburg

A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, signaling, bridges and buildings.
Communications on any topic suitable to our columns are solicited.
Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 10 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to the Railway List Company.
Papers should reach subscribers by the twentieth of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

This Publication has the largest paid circulation of any railway journal in the Maintenance of Way field.

Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

New Series, Vol. 8
Old Series, Vol. 27

Chicago, April, 1912 No. 4

CONTENTS.

Editorial—
- A. R. E. A. Registration ... 143
- Interest in Ordinary Construction ... 143
- Relation of Condition of Equipment ... 144

Railway Engineering Association ... 145
President's Address ... 145
Committee Reports:
- Rules and Organization ... 147
- Signals and Interlocking ... 148
- Iron and Steel Structures ... 149
- Ballast ... 151
- Wooden Bridges and Trestles ... 152
- Ties ... 153
- Track ... 157
- Yards and Terminals ... 162
- Rail ... 164
- Roadway ... 167
- Water Service ... 169
- Masonry ... 174
- Records and Accounts ... 177
- Electricity ... 177
- Conservation of Natural Resources ... 182
- Signs, Fences and Crossings ... 184
- Buildings ... 186
- Uniform General Contract Forms ... 189
- Economics of Railway Location ... 192
- Grading of Lumber ... 192
- Wood Preservation ... 195

Annual Dinner, A. R. E. A. Association ... 198
Three-Arch Concrete Bridge at Troy, N. Y. ... 199
The Signal Department—
- Railway Signal Association Convention Committee Reports.
  - Contracts ... 200
  - Power Interlocking ... 201
  - Automatic Block ... 202
  - Electric Railway and Alternating Current Signaling ... 204
  - Standard Plans ... 205
  - Wires and Cables ... 204
  - Storage Battery ... 205
- Interlocking at Georges Creek, Md. ... 206
- Improved Banding Drill ... 207

Maintenance of Way Department ... 208
- Bulletin of the Roadmasters and Maintenance of Way Association ... 208
- Surfacing ... 208
- Timber Preservation at Illinois University ... 208
- Portable Telephone Set in Track Work ... 209

Personals ... 209
With the Manufacturers ... 210
- Railway Telephone Accessories ... 210
- Gearon Composite Tie ... 210
- An Efficient Tie Plate ... 210
- Annual Meeting, National Railway Appliances Association ... 211
- Fairmount Motor Car ... 211
- Improvements in Rockford Motor Cars ... 212
- A Liquid Weed Killer ... 213
- Boiler Washing Water Recovery System ... 213
- Voting Contest, Indianapolis Switch & Frog Co. ... 214
- Industrial Notes ... 217

Unpolished Rails ... 219
Railway Construction ... 219
Recent Railway Engineering and Maintenance of Way Patents ... 220

A. R. E. A. Registration.

THE REGISTRATION of members at the 1912 convention of the American Railway Engineering Association was slightly in excess of that for 1911. Three hundred and eighty-six members registered this year. Mr. Belknap, president of the National Railway Appliances Association, stated at the banquet that the supply exhibit represented an expenditure of about one hundred and fifty thousand dollars. Some interesting deductions might be made from these figures.

Were the members of the Railway Engineering Association the only persons to whom the supply men wish to show their exhibits, then it is done at an approximate expenditure of three hundred and eighty-eight dollars for each railway official registered. We doubt if this expenditure would be considered, by the average supply manufacturer, as well warranted if such were the case. As is well known to all supplymen, however, the members of the Railway Engineering Association are in the minority among those railway men who annually make a study of the exhibits. This fact is best proven by the experience of one exhibitor, who conducted a guessing contest open to railway officials only. This exhibitor registered, at his booth, over nine hundred men who were qualified to vote in the contest in question. While this number doubtless includes most of the membership of the association in attendance, still it does not include all railway men who came to Chicago to view the exhibits. A conservative estimate of the number of railway men who visited the Coliseum would approximate fifteen hundred. This would cut the expense of the exhibit to about one hundred dollars per interested railway official. In some lines of endeavor this would be considered a prohibitive amount. In the railway supply business it is not so regarded. A hint as to who, aside from the members of the association, may be expected to view the exhibits may be obtained from the statement of an active member and the head of the engineering department of a large system which is as follows: "I do not wish one of my assistants or one of my roadmasters to miss the chance of self education represented in the Coliseum exhibit."

Interest in Ordinary Construction.

SEVERAL times recently our inquiries for information respecting some construction work have met with the response that the job was only an ordinary one, and not worthy of a detailed article in our columns. This shows an erroneous impression, which seems to be quite general, that the only work meriting a mention in a technical publication is that which is unique or entails unusual engineering features. Is this impression justified?

We think not. The work which most directly concerns the greatest number is ordinary work. For every extraordinary engineering achievement, there are a hundred or two ordinary ones. The ratio of men employed then would be somewhat the same; in other words, probably 100 men can get from an ordinary article practical ideas, which they can apply in their own individual cases, while only one out of a hundred may be able to apply principles shown in an extraordinary job.

There is another side to the question. Who has seen two exactly similar jobs, carried on in exactly the same way? Some such a condition as this exists when standards are

used. But even then it is usually the design which is standard, and not the methods. Again, standards and plans are changed frequently (too frequently the construction forces usually think). We must either progress or retrogress. Each job should show some improvement. And of course such improvements are the most interesting consideration to those directly concerned. But how about the outsider, or the less experienced man, who mayhap has not progressed as far? Your ordinary methods may be of untold value to him. We believe that there is scarcely any job involving the expenditure of even forty to fifty thousand dollars, which would not furnish some interesting information for publication.

Relation of Condition of Equipment to Accidents.

CERTAIN SO-CALLED "yellow" newspapers in New York and Chicago have been conducting a campaign against the New York Central Lines which for malicious misrepresentation is without precedent. The difficulties with which all railways have been contending in operating under the adverse conditions of a severe winter have been made to appear peculiar to the New York Central. A paragraph is given in nearly every issue of these papers showing the schedule of arrival of the fast trains of the system, attempting to convey the impression to the public that New York Central trains have been the only ones which have been running behind time to an unusual extent.

Among the institutions of modern civilization nothing is more dangerous than the dishonestly edited, ignorantly written articles of this nature published in newspapers of more or less wide circulation. Needless to say the journals in question are used and manipulated in cases of this kind as a means of getting back at the objects of wrath in instances of distinctly personal animosity on the part of the owner.

A wreck on the New York Central furnishes news which, after having been garbled in the most approved fashion of modern yellow journalism, beautifully serves the purposes desired. While headlines referring to rusty rails, soft ties and lax inspection bring nothing more than contemptuous smiles from those who know enough of railway operation to see the inconsistencies, the desired result as far as the general public is concerned is satisfactory to the instigator of this contemptible campaign.

These shafts are directed at a railway system which, for high standard of equipment and operation, has long more nearly approached the technical man's ideal than has that of any other. If there was any truth in the attacks the country would be in a bad way indeed with respect to its transportation lines. In so far as the cub reporters have gone in attempting to show that defective equipment has been used, nothing has been developed other than malicious falsehood and glaring inconsistency. This brings us, however, to consideration of the present situation with respect to railway equipment in general.

The frequency with which railway accidents of serious nature are occurring cannot but alarm those who have been watching the reports. Collisions have been in the minority, by far the larger number of the accidents that have been due to derailments and can be directly attributed to failures in equipment. The summer season will record a lesser number of accidents than have occurred in the months past. Cold weather is a factor tending to the disruption of railway traffic in many ways. We can, however, look forward to another series of serious accidents which will be terrifying to the public, with the beginning of cold weather in the fall of 1912.

Regulatory legislation is directly to be blamed for this condition. So expensive has it been to comply with the exactions of law made in the last four years by state and national legislative bodies, that the railways have been compelled to spend money, which otherwise could and would be used in the improvement of equipment, in carrying out the letter of these laws. Railway operation has been made so much more expensive within the last four years, that double the appropriations of four years ago would be necessary to maintain the equipment in average condition and at the same time comply with these laws. These larger appropriations have not been made; they have, indeed, been cut in most instances, and for good reasons. Absolute inability to make these appropriations, is the customary defense. Whether or not this defense will stand, is a question for the close student of high finance. The fact remains, they have not been made.

Were the ordinary thinking man to be confronted with the inside facts as to conditions as they really are, he would be at once amazed and alarmed. 60-mile-an-hour trains cannot be operated safely with 30-mile-an-hour equipment. Locomotives which should have received general heavy repairs a year ago will cause failures and accidents when continued in operation at the heads of fast trains. Tracks which should have been relaid and ballasted a year ago will not stand heavy fast traffic without danger of serious accident. We repeat that the condition of track and rolling stock the country over is such that were the millions, now being diverted to ineffective applications by regulatory legislation, appropriated at once for the proper channels, it would take several years to restore conditions to the normal.

This then is a situation the people of the United States must face at once. Service must be cut, schedules must be slowed down and economy must be practised in a different field. Whereas, heretofore retrenchment has meant reduction in the repair and purchase bills on ordinary equipment; future retrenchment must mean reduction of cost of haulage per passenger mile. This can be done in several ways, each of which means the elimination of what may be termed luxuries in travel. Rates have been determined by legislation. The necessary expenditures for the maintenance and purchase of equipment are fast being proved to have been too small for the last four years. Still net earnings are in a great many instances minus quantities and always too small to pay a proper conservative interest on investment.

The Chicago, Burlington & Quincy is planning the construction of a new roundhouse and turntable at Broken Bow, Neb.

The El Paso & Southwestern is planning the construction of a new passenger station at Douglas, Ariz., to cost $25,000.

American Railway Engineering Association

Report of 13th Annual Convention.

The first session of the 1912 convention of the Railway Engineering Association was opened at 9:30, Tuesday, March 10, at the Congress Hotel. W. C. Cushing, President, called the meeting to order. His address is quoted briefly as follows:

PRESIDENT'S ADDRESS.

At the last annual convention we numbered 967 members. During the year we have passed the 1,000 mark. However, our rate of growth has not been quite so rapid as formerly. The date of our fiscal year has been changed from March to December 31, and it is difficult to make exact comparisons. The largest number of new members in any one year was 124 in 1901; in 1904 we had 104, and in 1911, 98 new members. From March to December 31, 1911, 37 new members joined.

During the first years of the existence of the association a cash surplus was accumulated, but in the last three years the amount of printed matter issued has grown so that our expenditures have been in excess of our receipts, and the surplus has been drawn upon.

Your Board decided therefore that either the printing bill must be reduced, or the revenue increased, or both.

Your Board is unwilling as yet to recommend an increase in annual membership dues, but is arranging for the present to obtain additional revenue by employing an advertising agent to secure advertisements for the bulletins and program. It is estimated that this will net about $4,000 annually. The advertisements and methods of obtaining them will be closely supervised, but the members of the Board are opposed to the principle, and would not resort to it except in a case of emergency, and hope that the plan can be abolished at a future date.

The Board has given a great deal of study to the question of reducing the expenditures during the past year, and has made some changes after careful and energetic investigation of the publication committee and the secretary.

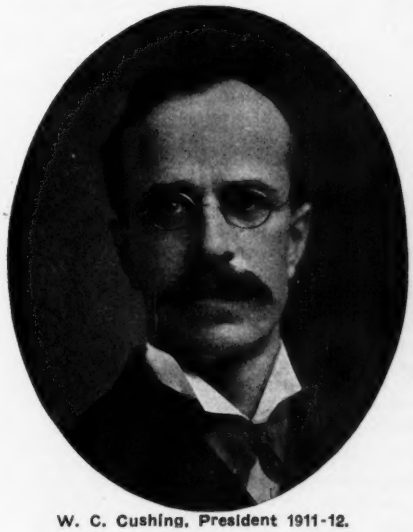
First in importance is the secretary's plan to avoid a reprinting of the reports after the convention by having a sufficient number of pages for the proceedings printed at the same time as the bulletins. The disadvantage is that the discussions will be collected together at the end of the volume, instead of appearing at the end of the reports to which they refer. This objection was not considered of sufficient importance in comparison with the saving in printing estimated to be about $1,000.

But 10 bulletins a year instead of 12 will be issued, the May and June numbers being omitted. This is because it is usually difficult to obtain articles for them, and the secretary is very busy at this time preparing for the publication of the proceedings. We expect the proceedings earlier on account of this arrangement. A reduction is to be made in the number of bulletins printed, so that it will be necessary for members to bring their copies with them to the convention. Extra ones will be provided for those who prefer to purchase them at cost at the convention.

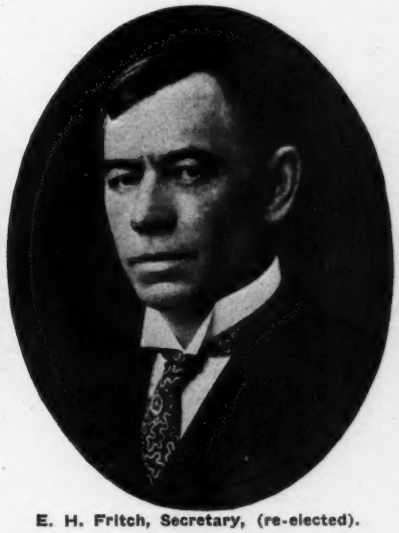
Further economy is expected in the reduction of postal rates by obtaining the second-class mail privilege. All the prescribed details of the post office have been complied with, among which is the altered appearance of the cover and establishment of regular subscription rates for our bulletins. The estimated reduction of expense for postage is about $500. We could not come under the regulations for this privilege till our association numbered 1,000 persons.

The Board of Direction has realized that the number of subjects reported on by committees was apt to be too many for thorough discussion, considering the large number of standing committees, and introduced Rule 8-b for the preparation of committee reports, which limited the number to two for action by the convention. A large number of subjects has been assigned each year, so that the committees could be collecting information for other reports to be presented a year or more hence. The Board found it necessary on account of the heavy expense to have the president issue a special circular to committee chairmen, calling attention to the necessity for enforcing the rule strictly this year. The several committees have responded heartily, and the results of their conscientious work is apparent in the valuable reports presented.

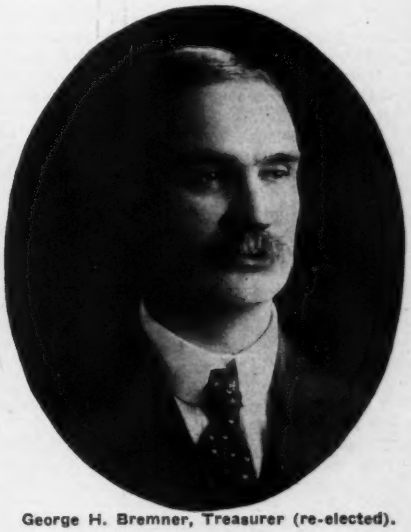
The ideal method of increasing our revenues would be to secure a larger membership, as the expense involved in issuing the bulletins and proceedings is not much more for a membership of 2,000 than for one of 1,000, while the revenue would be doubled. We are pleased with the present number of members, but it is evident that many who are eligible and who would be most desirable confrères have not yet identified themselves with us.



W. C. Cushing, President 1911-12.



E. H. Fritch, Secretary, (re-elected).



George H. Bremner, Treasurer (re-elected).

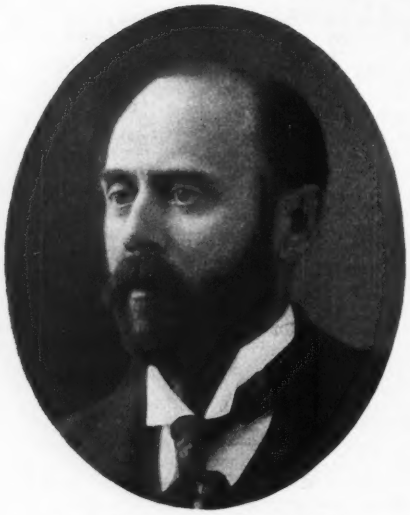
In view of the unauthorized use of extracts from our proceedings for advertising purposes your Board arranged for copyrighting all of our publications in the United States.

At the last convention important changes in our constitution were adopted, among which were the shortening of the name, the establishment of a nominating committee and the addition of three members to the Board of Direction. During the past year it was found desirable to make changes in the "General Rules for the Preparation, Publication and Consideration of Committee Reports, and the General Rules for the Publication of the Manual," in order to make the work of the association more expeditious and the papers and reports more valuable.

Prof. W. F. M. Goss, dean at the University of Illinois, has tendered the use of data collected by the university and the assistance of its staff, in the work of the Committee on "Economics of Railway Location."

In 1910 the money contributed by the American Railway Association for experiments and work in connection with the study of the rail problem was $6,213.57, while the amount subscribed by that association for 1911 is $10,000.

In the "Regulations adopted on December 28, 1911, by the superintendents of buildings of all five boroughs of the City of New York," regarding the use of reinforced concrete, a clause



C. S. Churchill, President 1912-13.

states "Steel for reinforcement of concrete shall meet the requirements of the standard specifications for steel reinforcement of the American Railway Engineering Association."

Three authors of new books to be published have recently asked the authority of your Direction to embody information contained in our proceedings in their books.

From these instances it is apparent that your work has attained such value that information from it is now constantly sought.

During the year 1911 the third edition of the manual was issued. This volume has been highly commended by members and others. The committees deserve these compliments, as do also Edwin F. Wendt, the reviewer, Prof. Pence, editor, and your secretary, E. H. Fitch.

The year 1911 has witnessed continued progress in some, and the completion of other vast engineering works. Governments continue their work in times of depressed business as well as in prosperous times, and, therefore, the three greatest government undertakings, the Panama Canal, the Catskill Aqueduct and the Erie Canal, have been pushed steadily forward.

Of these the Catskill Aqueduct, estimated cost $162,000,000, is of high importance, for it is to carry ultimately the water supply for 20,000,000 people.

Another important government enterprise, which was successfully completed last March, is the Roosevelt Dam, in the canyon of the Salt river, about 70 miles east of Phoenix, Ariz. The reservoir formed is for the purpose of impounding 418,000,000,000 gallons of water for irrigation. It is 276 ft. high, and nearly 1,100 ft. long.

In spite of the depression in business, the year witnessed the continued progress, and also the completion, of some magnificent engineering works in the railway world.

The erection of the enormous station of the New York Central Lines in New York City has been started, after carrying on since 1903 a large amount of preliminary work of excavation, tracklaying, etc. This work has totalled about 3,000,000 cu. yds. of rock excavation, carried on under great difficulties, about 250,000 cy. yds. of concrete and about 60,000 tons of steel.

On June 4, 1911, the large new Chicago passenger station of the Chicago & Northwestern, costing about $24,000,000, was opened for service. The train shed (Bush type) has 16 tracks, and belt conveyors are used for conveying some of the incoming mail.

An enterprise entirely different from any other was brought to successful completion in the last week of December, 1911, so far as the placing of the last batch of concrete was concerned. This is the famous Florida East Coast from Miami to Key West in Florida, 154 miles, of which 74 miles are on land, 25 miles on swamps and 55 miles over water or on the line of islands that make up the Florida Keys.

Another great railroad enterprise, estimated cost $9,500,000 is the cut-off of the Delaware, Lackawanna & Western Railroad, between Slateford, Pa., and Hopatcong, N. J., which was opened for traffic Christmas, 1911. The old line was shortened from 39.57 to 28.45 miles, the grade reduced from 1.14 to .55 per cent, and the curvature from 6 deg. 54 min. to 2 deg., except in the case of one of 3½ deg.

The Galveston causeway, estimated cost $1,615,000, was begun in 1909, and is a little more than 2 miles long, connecting Galveston island, on which the city of that name stands, with the mainland. The main feature is a reinforced concrete viaduct 2,455 ft. long, consisting of twenty-eight 70-ft. arch spans and a lift span with a clear waterway of 109 ft. This portion is 66 ft. wide, and carries 2 railway tracks, 1 electric railway track and a roadway 19 ft. wide.

The work of introducing electric power on steam railroads was continued. The Hoosac Tunnel was finished May 18, 1911, at a cost of 1¼ million dollars. The electrification is similar to that of the New York, New Haven & Hartford, and the zone extends from a small tunnel just west of the North Adams station to a point just east of the Hoosac Tunnel station. In all, 21 miles of track are being operated electrically.

Great engineering works are being carried on in other countries. The Swiss railway engineers have been obliged to resort to long and ingenious tunnel building, in order to prevent their land from becoming a barrier to international transportation. This country has the world's longest tunnel, the Simplon, 12.4 miles long; the St. Gothard, 9.5 miles long, and the past year witnessed the piercing of the third longest, the Loetschberg, 9 miles long.

The Panama Canal is the most costly and most stupendous enterprise now in progress, and its engineers are earning a monument of fame for themselves.

TREASURER'S REPORT.

Balance cash on hand March 15, 1911		$13,216.62
Consisting of:		
Ten railroad bonds as follows: Four St. Louis Southwestern bonds, par value $1,000 each, at cost	$ 3,319.31	
Six L. S. & M. S. Ry. bonds, par value $1,000 each, at cost	5,660.25	
Cash in bank	4,237.06	
Total	$13,216.62	
Receipts from all sources, March 16, 1911, to December 31, 1911		$23,716.69
Receipts from all sources, January 1, 1912, to March 15, 1912	10,538.44	10,538.44
Total receipts for the year		$34,255.13
Expenditures, paid on audited vouchers:		
March 16, 1911, to December 31, 1911	$25,602.96	
January 1 to March 15, 1912	3,766.70	
Total for the year		29,369.66
Balance to credit		$ 4,885.47
Less proceeds from sale of four L. S. & M. S. bonds		3,797.33
Net excess of receipts over expenditures.		$ 1,088.14
Balance, March 15, 1912:		
Cash in bank		$ 8,836.43
Cash on hand, checks, etc.		286.10
Four St. Louis S. W. bonds, at cost		3,319.31
Two L. S. & M. S. bonds, at cost		1,886.75
Total cash assets		$14,328.59

SECRETARY'S REPORT.

The secretary reported the following details of receipts for the year:

	March 16, 1911, to December 31, 1911.	January 1, 1912, to March 15, 1912.	Total.
From members (dues, etc.)	$ 5,274.48	$ 8,567.35	$13,841.83
From others (sales of publications, advertising, etc.)	6,853.59	1,394.91	8,248.50
From American Railway Association, account Rail Committee expense	6,495.57	508.56	7,004.13
From interests	295.72	67.62	363.34
From loan	1,000.00	.....	1,000.00
From proceeds of sale of bonds	3,797.33	.....	3,797.33
Total	$23,716.69	$10,538.44	$34,255.13

The contract for the construction of the steel and concrete bridge extending from the new Erie freight offices to the Chenango St. viaduct, Binghamton, N. Y., has been let.

It is reported that the Great Northern will construct seven steel bridges between Wenatchee and Whitefish, Wash., also 12 culverts to replace wooden bridges and fill seven other bridge approaches in connection with the relaying of the line with 90-lb. rails.

COMMITTEE REPORTS.

RULES AND ORGANIZATION.

Jos. O. Osgood, Chairman; G. D. Brooke, Vice-Chairman; F. D. Anthony, C. Dougherty, F. P. Gutelius, Jos. Mullen, S. E. Coombs, J. B. Carothers, Kenneth Hanger, J. A. Gordon, J. B. Dickson.

Last year's report of this Committee embodied revisions of the rules as then published in the Manual and additional rules of the same general character, all relating to the government of employes of the Maintenance of Way department.

For this year's work your Committee was instructed by the Board of Direction to: (1) Continue the compilation of rules for the government of Maintenance of Way employes. (2) Formulate rules in the nature of specifications or instructions regarding the conduct of work, making use of the recommendations of the various Committees dealing with these subjects and of the best practice of railway companies, as embodied in their books of rules.

Some progress has been made with rules falling under the first of the instructions, but this year's report deals only with the work falling under the second of the instructions.

Your Committee recommends: (1) That no change be made in the General Rules for the Government of Employes of the Maintenance of Way Department heretofore adopted by the Association. (2) That to the rules heretofore adopted by the Association be added instructions, as follows:

INSTRUCTIONS.

Cross-Sections.

(1) The roadbed, ballast and track shall conform to the standard plans. No changes in the sections shown shall be made without proper authority. (Note: It is understood that cross-sections for wet cuts will be included in the standard plants.)

Drainage.

(2) All ditches, including intercepting ditches on the upper side of cuts, must be kept clean.

(3) Where heaving or wet spots develop, special drainage shall be provided.

Ballasting.

(4) Before re-ballasting track, line and grade stakes shall be set by the Engineer. All unsuitable material shall be removed and the roadbed widened to proper section, the waste material being used to widen banks, or otherwise, as may be directed.

(5) Track must be kept in good line and surface while ballasting, open track avoided as far as practicable, and such track carefully watched.

(6) After ballast is distributed it shall be trimmed, and the track lined and surfaced to conform to the standard plans.

(7) Where track is bonded, ballast must be kept at least one inch below the base of rail. At road crossings, platforms, etc., where this is not practicable, only clean gravel or rock ballast shall be used.

Ties.

(8) Ties stored along right-of-way shall be piled to conform to the standard plan. (Note: The standard plan should show the minimum distance to the nearest rail.)

(9) The ties in track must be inspected at stated times each year and those which will not last until the next inspection marked for renewal.

(10) The renewal of ties shall be started when directed by the (Title) .....When ties are being renewed, the line and surface shall be corrected and ballast trimmed.

(11) All defective ties removed from track shall each day be placed for burning or loading on cars.

(Title)

(12) The..... shall frequently inspect ties removed from track to see if any have been removed which might have remained in the track with safety until the next inspection.

(13) Ties shall be spaced according to the standard plans. All ties shall be placed square to the line of rails. The outside ends on double tracks, and the ends on one side throughout on single track, must be lined parallel with the rail.

(14) The heart side of ties must be turned down. The largest and best ties shall be selected for use at joints. Twisted or badly hewn ties must not be notched, but the bearings must be made true with the adze.

(15) Whenever spikes are drawn from ties, wooden tie plugs must be driven into all holes except in ties which are to be renewed that season. In replacing spikes they should be driven into the plugs.

Rail.

(16) In unloading rails from cars they should be skidded or otherwise carefully lowered to avoid injury. Where it is necessary to drop them, both ends must be dropped together and the greatest care taken to avoid their falling on hard and uneven surfaces.

(17) The bottom of the new rail and the bearing surface of the tie shall be cleaned before the new rail is laid.

(18) When replacing rail with rail of the same section, only two rows of spikes shall be drawn; in replacing with a rail of a different section, three rows of spikes shall be drawn.

(19) In laying new rail, standard expansion shims shall be used. The temperature of the rail shall be taken by placing the thermometer on the rail. The openings between 33 ft. rails shall be as follows:

Temperature (Fahrenheit.)	Amount of Opening.
—20 deg. to 0 deg.	
0 deg. to 25 deg.	¼ in.
25 deg. to 50 deg.	3/16 in.
50 deg. to 75 deg.	⅛ in.
75 deg. to 100 deg.	1/16 in.

Over 100 deg. to be laid butting.

The rail should be laid without bumping and when practicable, laid rail by rail.

(20) The rails shall be brought squarely into line and at least two bolts tightened before spiking. All joint bars shall be securely fastened with the full number of bolts, tightening those at the center first. At permanent connections of rails of different sections, step chairs and offset splices must be used.

(21) Spikes must be driven vertically with the face in contact with the base of the rail. They should not be straightened while being driven. The rail must be spiked and the spikes staggered so that the outside spikes shall be on the same side of the tie and the inside spike on the opposite side.

(22) In making temporary connections in main track an old rail should be cut and fastened to the new rail, using compromise joints when necessary. Switch points shall be used for this purpose only during the presence of the Track Foreman.

(23) After new rail is laid the track must be lined and surfaced.

(24) All kinked or crooked rails must be straightened before being laid; if bent in service they must either be removed or straightened.

(25) Rails for curves of 2 degrees and over should be curved before being laid. In curving or straightening rails, the rail bender must be used.

(26) When surfacing (picking up low points or other low places), the general level of the track must not be disturbed.

For next year it is recommended that the Committee continue this year's work.

Discussion.

The report was taken up paragraph by paragraph.

F. D. Anthony.—I think that paragraph No. 6 should read "after ballast is distributed and the track is lifted, the track should be surfaced and lined and ballast trimmed to conform to standards." I move that this change be made. This motion was carried.

E. R. Tratman.—I think that the word "electrically" should be inserted in paragraph 7 before the word "bonded."

H. M. Church.—"Unsuitable material removed" should be inserted in paragraph 10 after "corrected."

E. R. Tratman.—In paragraph 12 we can dispense with the last words "in the track with safety until the next inspection."

The above suggestions were accepted by the Committee.

W. L. Webb.—I think that the last sentence of paragraph 14 should read "Twisted ties must not be simply notched with the adze but must be adzed the full length of the tie."

E. R. Lewis.—Paragraph 14 states that all ties must be layed heart side down. I think that ties should be layed heart side up, because the sap wood always dries out quicker than the heart if equally exposed. If sap side is layed up, it dries out so quick that it separates from the heart. Ties should be layed convex side up regardless of whether heart or sap is exposed. This rule is followed by all track men. The heart wood being the densest gives more resistance to mechanical wear. I move that the first sentence of paragraph 14 be changed to read, "Ties are to be layed with the side up which will give the best bearing." Motion was seconded and carried.

L. A. Downs.—In paragraph 15, I think we should add, "Treated tie plugs should be used in treated ties."

E. R. Lewis.—I move the last sentence of paragraph 16 be eliminated.

Motion seconded and lost.

Robert Ferriday.—In paragraph 18 I do not think we should define so positively the number of rows of spikes to be drawn. The number of rows it is necessary to withdraw depend on the section of the rail, previous gage of track, wear on rail, etc. I move that the words "if necessary" be added at the end of the paragraph.

Motion was seconded and carried.

E. R. Tratman.—I think that "compromise joints" should be used in paragraph 20 instead of "offset splices" and step joints. This paragraph would then show that the same device was meant as in paragraph 22. I think it would be clearer if only one name instead of three is used to describe this device.

This suggestion was accepted by the Committee.

L. A. Downs.—I move we eliminate the last sentence of paragraph 22.

Seconded and carried.

A. S. Baldwin.—Paragraph 24 says that all crooked rails must be straightened before laying in the track. I don't think rails of this sort should be used in main track.

C. C. Anthony.—The paragraph does not state they should be used in main track, but could mean they are to be used in side tracks.

Hunter McDonald.—If Mr. Baldwin is right in saying kinked rails are unfit for use after straightening, then it is bad practice to curve rails.

A. S. Baldwin.—Curving with a rail bender is a very gradual process, and therein differs greatly from a service bent rail. I have found a tendency in straightened rails to break at the point of the original kink.

H. T. Porter.—A surface bent rail is one bent vertically. Such a rail is very likely to be injured, if again straightened. A line bent rail can be straightened usually without the same harm. This difference is accounted for by the difference in the shape and resistance of the rail section in the different directions.

A. S. Baldwin.—I think that first quality rail, after being kinked and straightened, should be classed as second quality.

E. R. Lewis.—I move the paragraph be adopted as it stands.

Motion seconded and carried.

J. B. Berry.—I move to strike out the part of paragraph 26 in parenthesis.

The committee accepted the correction.

H. T. Porter.—I move the paragraph be amended by adding, "When picking up low joints or other low places, the general surface of track shall not be disturbed."

Mr. Porter accepted a suggestion to eliminate the first "low," and the amendment carried.

SIGNALS AND INTERLOCKING.

A. H. Rudd, chairman, L. R. Clausen, vice-chairman, Azel Ames, C. C. Anthony, H. Baker, H. S. Balliet, W. B. Causey, C. A. Christofferson, C. E. Denney, W. J. Eck, W. H. Elliott, G. E. Ellis, W. J. Harahan, M. H. Hovey, A. S. Ingalls, J. C. Mock, F. P. Patenall, J. A. Peabody, Frank Rhea, W. B. Scott, A. G. Shaver, T. S. Stevens, H. H. Temple, Edwin F. Wendt, J. C. Young.

A. H. Rudd, Chairman Committee on Signals and Interlocking.

The Board of Direction assigned four subjects for consideration:

(1) Continue investigation of outline and description of a comprehensive and uniform signal system, suitable for general adoption, conferring with proper committee of the American Railway Association.

(2) Revise mechanical interlocking specifications, and include wrought-iron pipe as well as steel.

(3) Revise electric interlocking specifications and submit statement of the results from experience.

(4) Report on the effect of treated and metal ties on track circuits.

Last year your committee presented revised specifications for various kinds of insulated wire, which the Association adopted. In order to bring these specifications into conformity with those adopted by the Railway Signal Association, a new insulation resistance table is herewith submitted.

Conclusion.

(1) The following table of insulation resistances in megohms per mile at sixty (60) degrees Fahrenheit for the various thicknesses of insulation in fractions of an inch and the various sizes of wire is made a part of the specifications for mineral matter, rubber compound, insulated signal wire for current of 660 volts or less, and the insulation resistance in megohms per mile, is revised to conform with this table.

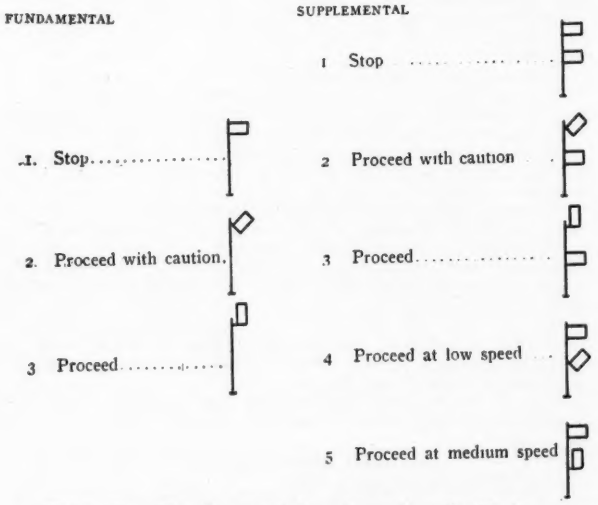
	3	2	5	3	7	4	5	6	7	8
	—	—	—	—	—	—	—	—	—	—
B. & S. G.	64	32	64	32	64	32	32	32	32	32
0.....	....	....	900	1100	1200	1300	1500	1800	2000	2200
1.....	....	....	1000	1200	1400	1500	1800	1900	2200	2400
2.....	....	1000	1100	1400	1500	1600	1900	2200	2300	2600
3.....	....	1100	1200	1500	1600	1800	2000	2300	2600	2700
4.....	....	1200	1400	1600	1800	1900	2200	2400	2700	2800
5.....	...	1300	1500	1700	1900	2000	2300	2600	2800	3100
6.....	....	1400	1600	1800	2000	2200	2600	2800	3100	3400
8.....	1400	1600	1900	2200	2300	2600	2800	3200	3500	3800
9.....	1500	1800	2000	2300	2600	2700	3100	3400	3600	3900
10.....	1600	1900	2200	2400	2700	3000	3200	3600	3900	4200
12.....	1800	2200	2500	2800	3100	3200	3600	4000	4300	4600
14.....	2200	2600	2800	3200	3500	3600	4200	4400	4800	5100

(2) The above table of insulation resistances in megohms per mile at sixty (60) degrees Fahrenheit for the various thicknesses of insulation in fractions of an inch and the various sizes of wire is made a part of the specifications for mineral matter, rubber compound, insulated aerial braided cables for current of 660 volts or less, and the insulation resistance megohms per mile, is revised to conform thereto.

(3) The above table of insulation resistances in megohms per mile at sixty (60) degrees Fahrenheit for the various thicknesses of insulation in fractions of an inch and the various sizes of wire is made a part of the specifications for mineral matter, rubber compound, insulated, lead-covered, armored submarine cables for 600 or lower voltage service, and the insulation resistance megohms per mile is revised to conform thereto.

Your committee does not report this year on subjects Nos. 2, 3, or 4, assigned by the Board of Direction.

(The majority report on uniform signaling is essentially the same as that given before the Railway Signal Association and reported in *Railway Engineering*, November, 1911, page 512. The majority report, together with the minority report was accepted by the Railway Engineering Association as information. We publish the minority report herewith.)



Note.—Stop Signals operated under automatic block system rules shall be designated by a number plate.

Minority Report of Committee on Signals and Interlocking.
H. S. Baker, W. B. Scott, T. S. Stevens, J. C. Young, L. R. Clausen.

We recommend that the following indications specified by the committee on transportation of the American Railway Association and the aspects used to represent them be accepted and approved as recommended practice:

The specific objections to the additional indications and aspects provided by the majority are the same as previously presented to this Association and are in accordance with the arguments presented before the transportation committee of the American Railway Association at Niagara Falls in June, 1910.

They are as follows:

1. It is impracticable to provide a separate signal for each of the conditions on a railroad requiring cautious running and to maintain the fine-haired distinctions necessary to their interpretation.

2. It is unnecessary, and, in fact, dangerous, to tell the engineman by fixed signal how he shall control his train at some point in advance.

3. Advance information so given is misleading and unreliable, as it is subject to change without notice, and therefore the engineman cannot safely use it. If he does so use it, it is done at the expense of safety.

4. The conditions of modern railway operation do not require trains to be run at full speed past caution signals, and any time gained by this practice is at the expense of safety.

5. Each signal should indicate Stop or Caution or Proceed, and have no relation to signals in advance or in the rear.

6. Each signal should be observed in turn as the train comes to it, and not at some point in advance at the option of the engineman.

7. With signals properly located, it is time a train should be run with caution if it has reached a point so close to preceding trains or Stop signals in advance that a Caution signal is received.

8. No Proceed or Caution indication should "imply or assure clear track to a point in advance." Railway signaling devices and our methods of communication have not reached the perfection that will admit of this being done. We cannot know positively if the track is clear, and further, it may not stay clear. We are under a moral obligation not to give such misleading information.

9. The giving of information by signal indications about conditions in advance, whether it be regarding the next signal or the next station, or any other object or condition, is wrong practice, productive of laxity and a fruitful source of danger and accident.

10. It will be difficult, if not impossible, to maintain discipline and proper observance of the great variety of Caution indications proposed by the majority, because of the fine distinctions involved.

A number of serious and fatal accidents in the past few years, wherein the engineman failed to properly observe the Caution signal, but fully intended to stop at the next signal, testify most conclusively to the correctness of our position in this matter.

Discussion.

L. R. Clausen moved that the table of resistances be accepted for publication in the manual.

Motion seconded and carried.

L. R. Clausen: Since the report of a similar committee of the Railway Signal Association has been rejected by that association, I move that the portion of this report on "Uniform Signaling" be accepted as information.

Motion was seconded and carried.

IRON AND STEEL STRUCTURES.

C. H. Cartlidge, chairman, A. J. Hines, vice-chairman, J. A. Bohland, Charles Chandler, C. L. Crandall, J. E. Crawford, J. E. Greiner, J. M. Johnson, C. N. Monsarrat, W. H. Moore, Albert Reichmann, A. F. Robinson, C. C. Schneider, O. E. Selby, C. E. Smith, I. F. Stern, F. E. Turneaure.

Subject No. 1—Investigation on Impact and Secondary Stresses: Appendix B contains a report from Prof. F. E. Turneaure, chairman of sub-committee on impact, giving an outline of the work done by the committee during the past year.

Subject No. 2.—Influence of Theory, Experiment and Experience on Bridge Design: It was unanimously decided by the committee that it was unable to report adequately on this subject, and the request is therefore made the subject be dropped.

Subject No. 3—Rules for Instruction and Guidance of Inspectors in Mills, Shop and Field: The committee reports progress. The chairman of the sub-committee has received discussion from two of the members of his sub-committee, and will probably be able to submit a paper giving the results of their findings during the next few months.

Subject No. 4—Design of Built-up Columns: The tender of the services of this committee to collaborate with the joint committee of the American Society of Civil Engineers was made and very promptly accepted. Sufficient time has not yet elapsed to permit the organization of any actual work on this subject. The program proposed by the A. S. C. E. committee is very elaborate and comprehensive and when carried out will immensely increase our knowledge of the subject. In order that this committee do any practical work on this subject, it will be necessary to have funds. Your committee understands, of course, that none of the funds of the Association are available for this purpose. We feel warranted, however, in recommending that individual roads be asked to contribute for the purpose of making these tests. This work and that of the Impact Committee are original research work and it is hardly necessary for us to point out the ultimate value of the work done in the manner in which it has been done. It will probably be necessary in the near future to take cognizance of these experiments in our specifications for design, but the committee does not recommend that any change be made at present, nor until further experiments on secondary stresses have been made, and if possible, considerable work on columns. The committee will present later a more definite report of the probable amount of money needed for the first year's work. It is expected that this will be very small and that it can easily be raised.

Subject No. 5—Specification for Erection of Steel Bridges: In Appendix A the committee presents for the consideration of the Association a set of specifications, revised in accordance with the discussion at the last convention and with the written discussions from members and others received since the convention.

Conclusions.

The recommendations of the committee are as follows:

(1) That the specifications for Bridge Erection be adopted and printed in the manual.

(2) That the report of the Impact Committee be received as information.

(3) That no change be made at present in the specifications printed in the manual.

APPENDIX A.

Specifications for the Erection of Railroad Bridges.

Work to Be Done.

1. The contractor shall erect, rivet and adjust all metal work in place complete, and perform all other work hereinafter specified.

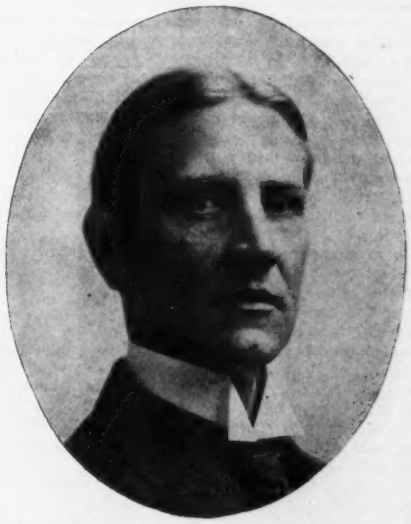
Plant.

2. The contractor shall provide all tools, machinery and appliances necessary for the expeditious handling of the work, including drift pins and fitting up bolts.

Falsework.

3. The method of erection and plans for falsework and erection equipment shall be subject to approval by the engineer, but such approval shall not relieve the contractor from any responsibility. Falsework will be built by *..... Falsework material of every character will be provided by the *.....

The temporary structure for use during erection and for maintaining the traffic shall be properly designed and substantially constructed for the loads which will come upon it. All bents shall be thoroughly secured against movement, both transversely and longitudinally. The bents shall be well secured against settling,



C. H. Cartlidge, Chairman Committee on Iron and Steel Structures.

and piles used wherever firm bottom cannot be obtained. Upon completion of the erection, the temporary structure, if the property of the railway company, shall be removed without unnecessary damage, and neatly piled near the site or loaded on cars, as may be directed. If the property of the contractor, it shall be removed in a manner subject to the approval of the engineer.

Falsework placed by the railway company under an old structure or for carrying traffic, may be used as far as practicable by the contractor during erection, but it shall not be unnecessarily cut or wasted.

Conduct of Work.

4. The work shall be prosecuted with sufficient force, plant and equipment to expedite its completion to the utmost extent and in such a manner as to be at all times subordinate to the use of the tracks by the railway company, and so as not to interfere with the work of other contractors or to close or obstruct any thoroughfare by land or water, except under proper authority.

Reasonable reduction of speed will be allowed upon request of the contractor.

Tracks shall not be cut nor shall trains be subject to any stoppage except when specifically authorized by the engineer.

The contractor shall protect traffic and his work by flagman furnished by and at the expnese of the railway company. The con-

*Insert "Railway Company" or "Contractor," as the case may be.

tractor shall provide competent watchmen to guard the work and material against injury.

Engine Service.

5. If under the contract, work train or engine service is furnished the contractor free of charge, such service shall consist only in unloading materials and in transferring the same from a convenient siding to the bridge site. Other engine service shall be paid by the contractor at the rate of $..... per day per engine, the time to include the time necessary for the engine to come from and return to its terminal. When engine service is desired the contractor shall give the proper railway officials at least 24 hours' advance notice and the railway company will furnish the service as promptly as possible, consistent with railroad operations.

When derrick cars are used on main tracks, their movements shall be in charge of a train crew, and the expense of the crew and any engine service other than as noted above shall be charged to the contractor.

Transportation.

6. When the transportation of equipment, materials and men is furnished free over the railway company's line, it shall be subject to such conditions as may be stated in the contract.

Masonry.

7. The railway company will furnish all masonry to correct lines and elevations, and unless otherwise stated in the contract, will make all changes in old masonry without unnecessarily impeding the operations of the contractor. The railway company's engineers will establish lines and elevations and assume responsibility therefor, but the contractor shall compare the elevations, distances, etc., shown on plans, with the masonary as actually constructed as far as practicable, before he assembles the steel. In case of discrepancy, he shall immediately notify the engineer.

Handling and Storing Materials.

8. Cars containing materials or plant shall be promptly unloaded upon delivery therefor, and in case of failure to do so the contractor shall be liable for demurrage charges. Material shall be placed on skids above the ground, laid so as not to hold water ,and stored and handled in such a manner as not to be injured or to interfere with railroad operations. The expense of repairing or replacing material damaged by rough handling shall be charged to the contractor. The contractor, while unloading and storing material, shall compare each piece with the shipping list and promptly report any shortage or injury discovered.

Maintenance of Traffic.

9. When traffic is to be maintained it will be carried on in such a manner as to interfere as little as practicable with the work of the contractor.

Changes in the supporting structure or tracks required during erection shall be at all times under the direct control and supervision of the railway company.

Removal of Old Structure.

10. Unless otherwise specified, metal work in the old structure shall be dismantled without unnecessary damage and loaded on cars or neatly piled at a site immediately adjacent to the tracks, and at a convenient grade for future handling, as may be directed. When the structure is to be used elsewhere all parts will be matchmarked by the railway company, when the old bridge is composed of several spans the parts of each shall be kept separate.

Metal Work.

11. Material shall be handled without damage. Threads of all pins shall be protected by pilot and driving nuts while being driven in place.

Light drifting will be permitted in order to draw the parts together, but drifting for the purpose of matching unfair holes will not be permitted. Unfair holes shall be reamed or drilled.

Nuts on pins and on bolts remaining in the structure shall be effectively locked by checking the threads.

All splices and field connections shall be securely bolted prior to riveting. When the parts are required to carry heavy traffic, important connections, such as attachments of stringers and floor beams, shall have at least fifty (50) per cent. of the holes filled with bolts and twenty-five (25) per cent with drift pins. All tension splices shall be riveted up complete before blocking is removed. When not carrying traffic, at least thirty-three and one-third (33 1-3) per cent of the holes shall have bolts.

Rivets in splices of compression members shall not be driven until the members shall have been subjected to full dead load stresses. Rivets shall be driven tight. No recupping or calking will be permitted. The heads shall be full and uniform in size and free from fins, concentric and in full contact with the metal. Heads shall be painted immediately after acceptance.

Rivets shall be uniformly and thoroughly heated and no burnt rivets shall be driven. All defective rivets shall be promptly cut out and redriven. In removing rivets the surrounding metal shall not be injured; if necessary, the rivets shall be drilled out.

Misfits.

12. Correction of minor misfits and a reasonable amount of reaming shall be considered as a legitimate part of the erection.

Any error in shop work which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, and a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the engineer and the work of correction done in the presence of the engineer, who shall check the time expended.

The contractor shall render an itemized bill for such work of correction for the approval of the engineer.

Anchor Bolts.

13. Holes for all anchor bolts, except where bolts are built up with the masonry, shall be drilled by the contractor after the metal is in place and the bolts shall be set in Portland cement grout.

Bed Plates.

14. Bed plates resting on masonry shall be set level and have a full even bearing over their entire surface; this shall be attained by either the use of Portland cement grout or mortar, or by tightly ramming in rust cement under the bed plates after blocking them accurately in position.

Decks.

15. The *..... will frame and place the permanent timber deck.

Painting.

16. The paint will be furnished by *..... and shall be of such color, quality and manufacture as may be specified.

Surfaces inaccessible after erection, such as bottoms of base plates, tops of stringers, etc., shall receive two coats of paint before assembling in place. After erection, the entire structure shall receive two coats of paint, allowing enough time between coats for the first coat to dry before applying the second. No paint shall be applied in wet or freezing weather, nor when the surface of the metal is damp. Painting shall be done in good and workmanlike manner, subject to strict inspection during progress and after completion, and in accordance with special instructions which shall be given by the Engineer. All metal shall be thoroughly cleaned of dirt, rust, loose scale, etc., before the paint is applied.

Clearing the Site.

17. The Contractor, after completion of the work of erection, shall remove all old material and debris resulting from his operations and place the premises in a neat condition.

Superintendence and Workmen.

18. During the entire progress of the work the Contractor shall have a competent superintendent in personal charge and shall employ only skilled and competent workmen. Instructions given by the Engineer to the superintendent shall be carried out the same as if given to the Contractor. If any of the Contractor's employes by unseemly or boisterous conduct, or by incompetency or dishonesty, show unfitness for employment on the work, they shall, upon instructions from the Engineer, be discharged from the work, nor thereafter be employed upon it without the Engineer's consent.

Inspection.

19. The work of erection shall at all times be subject to the inspection and acceptance of the Engineer.

Responsibility.

20. The Contractor shall assume all responsibility for loss or damage to his own work, materials or plant, due to any cause; also, for all loss or damage to the Railway Company's materials or property, and to other property adjacent to the railroad, due to causes within his reasonable control.

The Contractor shall assume all responsibility for injury to the workmen and the public, or to any individual; and in case of accident or suit he shall defend the suit in person and relieve the Railway Company from all costs and expenses, and pay any judgments that may be recovered thereon.

The Contractor shall comply with the laws and ordinances affecting the manner of doing work; shall take out all necessary permits and comply with their requirements, and shall take such precaution as may be necessary to protect life and property.

Insurance and Bond.

21. The Contractor shall carry such liability insurance as is necessary to protect himself and the Railway Company against loss or damage caused by injuries to his men, and shall furnish the Railway Company a bond in form and of a surety acceptable to the Railway Company, providing for the faithful performance of the work and all matters pertaining thereto, in such sum as shall be specified in the contract.

Engineer.

22. The term "Engineer," as used herein, shall be understood to mean the Chief Engineer of the Railway Company, or his accredited representative.

APPENDIX B.

Secondary Stresses.

We herewith submit a brief report of progress relative to tests of secondary stresses, which were carried out during the past summer by your Sub-Committee on Impact and Secondary Stresses.

*Insert "Railway Company" or "Contractor," as the case may be.

Through the assistance of the mechanician's shop at the University of Wisconsin, we were able to develop and manufacture a special form of extensometer for use in measuring secondary stresses. An important requirement of such an instrument is freedom from friction of all moving parts and, in general, a high degree of sensitiveness, combined with stability and strength of framework, convenience of adjustment and manipulation. An instrument was developed along the line of the extensometers used for impact tests, but to secure sensitiveness the principal bearings were made of knife edges, and instead of using a pencil for securing a continuous record, a ray of light is allowed to pass through a minute perforation in a disc at the end of the long lever, and a path of this ray of light is photographed on a moving slip of sensitized paper.

The apparatus proved satisfactory in practical operation, and the method of obtaining the record was found to be very good indeed. The sensitized paper was developed in the field so that results could quickly be obtained.

Four of these extensometers were made by the University of Wisconsin and were used by the Committee on its tests.

About three weeks were spent in the field and tests were made on the following bridges:

On the Chicago, Milwaukee & St. Paul, a 160-ft. riveted span and a 176-ft. pin-connected span at Byron, Ill., a 104-ft. pony truss span at Rockton, Ill., in which eye-bars were used for the diagonal members, and a span of the same length at Brodhead, Wis., in which all members were riveted.

On the Chicago & North-Western a 182-ft. riveted truss, a 75-ft. deck-plate girder, and a through riveted lattice truss, all on the new Belt Line at Milwaukee.

At the present time preliminary results only are available, which are not in form for publication.

In all of these tests the Railroad Company furnished a special train, and such other facilities in the way of mechanics, as were needed; and your Sub-Committee desires here to express its great appreciation for the assistance thereby rendered.

The field work was carried out by Professors C. L. Crandall and F. E. Turneaure, members of the Sub-Committee, assisted by Messrs. W. L. Conwell and W. A. Axtell, of Cornell University, and Messrs. W. S. Kinne, O. L. Kowalke and J. B. Kommers, of the University of Wisconsin.

C. L. CRANDALL,
F. E. TURNEAURE,
Sub-Committee on Impact.

Discussion.

A. S. Baldwin.—I think that the last paragraph in clause III, referring to the use of the company's falsework, is a special case, and should therefore be omitted.

H. T. Porter.—I think this paragraph covers many cases, and I see no objection to leaving it there.

A. S. Baldwin.—I move the clause be modified to read, "If falsework has been placed under an old structure by the railway company, its use by the contractor must be subject to a special agreement to be made by the engineer of the company."

C. H. Cartlidge.—We tried to make these specifications to cover as wide a range of uses as possible, and I think the paragraph should remain.

H. T. Porter.—If the paragraph is left in, more bids could be called for under the specifications without change, which is desirable.

F. J. Bachelder.—It seems to me this matter is settled by paragraph 1, in section III, and that paragraph 3 is therefore superfluous.

The motion to eliminate paragraph 3 of section III was lost.

E. A. Fink made a motion to the effect that a paragraph should be added to section 4, stating that if the speed limit in a slow order is exceeded, contractor is not entitled to reimbursement for any damage resulting.

Thomas Earle.—I think the addition of the suggested clause would nullify the rest of that paragraph.

F. J. Bachelder.—This clause simply provides for a reasonable reduction of speed, and I think it should stand as written.

H. T. Porter.—I move the following amendment: "Reasonable reduction of speed can be provided in contract, on the request of contractor."

The President stated this motion was out of order. The motion to amend the section was lost.

A. S. Baldwin.—I think the cost of work train service should be divided between the contractor and railway company. I find this tends to reduce the train service required.

E. F. Wendt.—Our company furnished free transportation for material, and also free work train service. Owing to inconveniences, we now accept bids on one basis only, i. e., the bid must include all transportation of both men and materials, and all work train service. This is very satisfactory, and it relieves the engineer of a good deal of trouble.

Thos. Earle.—I think the 4th paragraph of section 11 should be changed to read 50 per cent of the holes should be filled with drift pins, and 25 with bolts. The drift pins fill the holes entirely and take all the stress in a joint which has bolts also.

C. H. Cartlidge.—I think it is conceded that a good many of our structures are carried on friction. The drift pins are tapered, and give a contact at only one point, so I fail to see wherein they are superior to bolts.

Appendix "A" was adopted for publication in the manual with the exception of 20 and 21, which the chairman stated the committee would withdraw.

Appendix "B" was accepted as information.

BALLAST.

H. E. Hale, Chairman; J. M. Meade, Vice-Chairman; W. J. Bergen, A. F. Blaess, T. C. Burpee, F. T. Darrow, J. M. Egan, T. W. Fatherson, H. L. Gordon, G. H. Harris, C. C. Hill, S. A. Jordan, A. S. More, J. V. Neubert, S. B. Rice, E. V. Smith, F. J. Stimson, S. N. Williams.

Report on the Proper Depth of Ballast to Insure Uniform Distribution of the Loads on the Roadbed.

The report the Committee on the proper depth of ballast submitted during the year 1910 was in the form of a progress report, accompanied by a table showing the approved depth of ballast on various railroads, but on account of lack of sufficient information on which to base definite recommendations, no action was taken on this subject by the Association.

Your Committee feels that very valuable information was given to the Association in the report of the Pennsylvania Railroad Committee on the necessary depth of stone ballast, published in Bulletin 136, through the kindness of Mr. W. C. Cushing, President of the American Railway Engineering Association, and Mr L. R. Zollinger, Chairman of the Committee, appointed by the General Manager of the Pennsylvania Railroad.

The tests made by the Pennsylvania Railroad at Altoona indicate that with approximately 320,000 to 440,000-lb. axle loads, or 75,000 lbs. each, passing over test ties on the test ballast,

H. E. Hale, Chairman Committee on Ballast.

at five miles per hour, the subgrade practically reached a permanent settlement, and that where the ballast was materialy less than 24 in., the settlement of the subgrade (loam) under the ballast was not uniform, but showed a greater settlement under the ties than between the ties.

These experiments further indicated that when stone ballast was placed 24 in. deep under the ties, the settlement of the subgrade (loam) under the ballast was practically uniform, and therefore the pressure must have been approximately uniform.

It was also found that a combination of stone and cinder ballast 24 in. deep under the ties (lower layer of cinders 18 in. to 14 in. deep, upper layer of stone 6 in. to 10 in. deep) gave nearly as good results, although the deformation of the subgrade was greater than with 24 in. of stone ballast.

The result of this series of tests, which indicated that approximately 24 in. of stone ballast is required to produce a uniform pressure on the subgrade, with the ties spaced 24 in. to 25.5 in., center to center, agrees very closely with the formula given by Mr. Thomas H. Johnson, in the Proceedings of the American

Railway Engineering and Maintenance of Way Association, Vol. 7 (1906), which was derived from the experiments of Director Schubert, namely, that with ties spaced 23 in. apart, center to center, stone ballast should be 22 2-3 in. deep to produce uniform pressure on the subgrade.

Conclusion.

With the data available, your Committee finds that with the ties (7 in. by 9 in. by 8½ ft.) spaced approximately 24 in. to 25.5 in., center to center, a depth of 24 in. of stone ballast is necessary to produce uniform pressure on the subgrade, and a combination of a lower layer of cinder ballast (18 in. to 14 in.) and an upper layer of stone ballast (6 in. to 10 in.), approximately 24 in. deep in the aggregate, with the same spacing of the ties will produce nearly the same results.

Report on Physical Tests of Stone for Ballast.

The Physical Tests of Stone for Ballast adopted by the Association and described in Vol. 11 (1910), were the first tests of this character adopted by the Association, and the question of revising the tests, if necessary, or adding other tests to those adopted, was again referred to the Ballast Committee for further investigation and consideration.

Your Committee ascertained that the railroads as a rule had no uniform practice in making physical tests of stone for ballast. Some of the roads selected their stone for ballast by simply observing the character of the stone, and then ascertaining its durability and fitness for ballast by the actual results obtained in track. Some roads required a compression test in their specifications, but only one railroad was found to have used the physical tests made by the United States Government, previous to their adoption by the Association, as above referred to.

Your Committee does not recommend any changes in the physical tests already adopted, but feels that the tests would be more complete if the compression test were added.

With this in view, the question was taken up with the Department of Agriculture of the United States Government at Washington, D. C., and they have agreed to add the compression test to those adopted by the Association.

The description of the compression test, which the Government will make, is as follows:

A cylinder two (2) in. in diameter and more than two (2) in. long is drilled from the specimen of stone to be tested, by means of a diamond core drill, and sawed to a length of two (2) in. by a band saw fed with emery. The specimen is finally faced off on each end by means of a power-driven grinding lap, on which water and emery are continuously fed.

The cylinder then has both ends embedded in plaster of paris, the bed being made as thin as possible and both ends being made parallel. The cylinder is next mounted on an Olsen test machine on a special bearing block between blotting papers, three thicknesses being placed at each end, between the cylinder and the steel-bearing faces of the machine. The load is then applied at a speed of 0.152 in. per minute, the machine being kept balanced during the application of the load.

Your Committee believes that with the physical tests of stone for ballast, which the Association adopted, and the compression test above described, sufficient information will be given by which to compare the character of stone from the various quarries from which it is proposed to obtain ballast.

The advantage of using approved physical tests of stone for ballast is to determine the character of the stone and its fitness for ballast without the expense of opening quarries and using the stone, before it is known whether it will be suitable for ballast or not, and without some method of determining this by physical tests, railroads will undoubtedly be put to considerable expense by opening quarries and applying stone ballast, which in some cases will have to be replaced with better ballast from other quarries.

Conclusions.

Your Committee recommends that in addition to the Physical Tests of Stone for Ballast, which have been adopted by the Association, that the "Compression Test," above described, be adopted and included in the manual.

Your Committee also recommends that the following reference be made in the Manual to the description of the tests and the action necessary to have tests made:

"For the description of the physical tests of stone for ballast as recommended by the Association and full instructions as to how the samples should be obtained and shipped to the Government, see Proceedings of the American Railway Engineering and Maintenance of Way Association, Vol. 11, Part 2, pp. 910-914, and report of Ballast Committee of 1912. If blueprints of the machines used in making the tests are desired, they can be obtained from the Department of Agriculture, United States Government, Washington, D. C."

Complete Review of Gravel Ballast and Recommended Methods for Grading the Different Qualities.

In the Proceedings of the American Railway Engineering and Maintenance of Way Association, of 1910, Vol. 11, pp. 909-932, a classification of gravel ballast was adopted by the Association which depended on the amount of sand and dust found in the gravel, the size of the sand, and the size of the gravel, being determined in accordance with the definitions of "Sand and Gravel" given in the Manual, and this subject was again referred to the Ballast Committee for a complete review.

Your Committee, during the year, requested a number of railroads to test their gravel ballast and determine the percentage of sand, gravel (following the definitions of sand and gravel, given in the Manual), dust etc., in the ballast.

The Atchison, Topeka & Santa Fe Railway reports that it is using the Chillicothe gravel almost entirely and finds it to be very satisfactory, giving good results on the roadbed, as it comes from the pit, using 12 in. under the ties.

The Chicago, Burlington & Quincy reports show gravel being taken from four different places, and put under the tracks as it is loaded from the pits, which makes excellent track, binds well and is easily worked.

The Chicago, Rock Island & Pacific reports gravel taken from five different places, the best being from Benton, Ark., on their Southern lines, but not equal to the glacial gravel of Iowa and Illinois.

In the case of the Illinois Central, information was obtained through tests from four different places, and the ballast from each is used in the track as it comes from the pits, except in the case of the Memphis gravel, which is taken from the bed of the Mississippi River and washed.

The Missouri Pacific reports tests from three different places, and like the other roads the ballast was used on the track as it came from the pits.

It will be seen from the reports of the six different roads that no expense was incurred in washing or screening the gravel, which was used upon the tracks as it came from the pits, except in the case of the Illinois Central, for gravel secured at Memphis.

A report from the Chief Engineer of the Intercolonial of Canada states that he is of the impression that if they screened their gravel they would not get as good results as where they took the sand with a coarser material combined.

A report from the Engineering Department of the Canadian Pacific states that they are ballasting with gravel taken direct from the pit, without any cost of treatment.

Your Committee further endeavored to determine the maximum amount of clay which would be permissible in good cementing ballast, and by reference to the data we have on this subject we find that most of the tests that have been made of gravel ballast give very meager information as to the amount of clay in cementing ballast, but from the best information we have at hand we are of the opinion that where the clay amounts to over 10 per cent it would be quite objectionable.

Your Committee wishes to give a high endorsement of the report on "Gravel as Ballast," by Mr. C. Brauning, which Mr. W. M. Dawley had translated from "Zeitschrift fur Bauwesen,"

Conclusions.

Your Committee recommends further investigation of the amount of sand, dust and clay permissible in good gravel ballast, since reports obtained this year from various railways indicate wide variations in the amount of these materials found in gravel ballast in actual use, yet reported as giving good results.

Discussion.

C. A. Morse.—Ten or fifteen years ago I had some experience with a piece of track with from 18 ins. to 2 ft. of cinders, underlying slag ballast. This track showed an abnormal amount of settling.

C. S. Churchill.—It is sometimes impossible to obtain the tools for making the test of stone ballast as described, and I think that we should have some form of test which could be more easily made by the railways. We have made tests by means of cubes cut with a chisel, and we find it easy to determine the relative strength in that way.

H. E. Hale.—The physical tests recommended have been widely used, and are the most complete set of physical tests for stone that the committee found, and we think it advisable to accept them, since the Government will make the tests of sample free of charge.

A motion was made and carried to accept the report of the Committee.

A motion was passed to make a reference in the Manual to the physical tests for stone ballast.

WOODEN BRIDGES AND TRESTLES.

C. C. Wentworth, Chairman; W. F. Steffens, Vice-Chairman;

F. H. Bainbridge, F. E. Bissell, W. S. Bouton, R. D. Coombs, E. A. Hadley, Hans Ibsen, Henry S. Jacoby, J. A. Lahmer, H. Rettinghouse, I. L. Simmons.

The work assigned by the Board of Direction for the year 1911 was as folows:

(1) Report on the formulas for use in determining the strength of sheet piling.

(2) Report on equipment required for pile driving.

(3) Collect information on special methods of driving sheet piles in cofferdams where conditions do not permit the use of ordinary equipment.

(4) Collect information on actual experience on the bearing power of piles and on the practical results of the use of formulas.

(5) Report on the use of guard rails for wooden bridges and trestles.

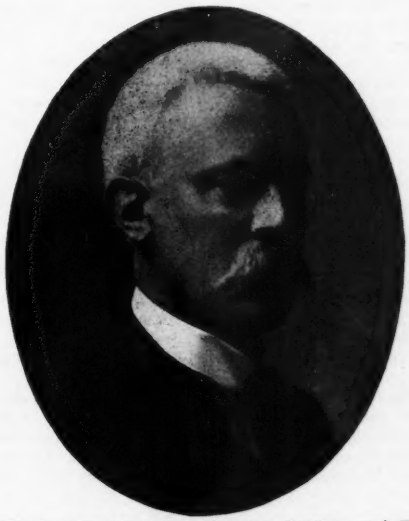
(6) Report on fire protection of wooden bridges and trestles.

The following subjects were selected for consideration this year: Nos. 1, 4, 5 and 6 of the foregoing list. The Committtee reports its progress thereon as follows:

(1) Sheet Piling—Prof. H. S. Jacoby, Chairman; and H. Ibsen, Sub-Committee:

This subject Committee VII did not think could be reported on this year, as an experimental investigation, which it was hoped Cornell University would make, could not be completed in time for report if undertaken, and it was thought that the result of these experiments would be of much service in making up its final report to the Association. The Committee has since been advised that Cornell could not undertake these experiments, but the Committee hopes that some other Institution may find it desirable that they be carried out by it.

The procedure suggested for these experiments was that a strong concrete open top box be made, across which at its middle a vertical plate diaphragm of tempered spring steel could be set; this diaphragm being held in place against horizontal motion at



C. C. Wentworth, Chairman Wooden Bridges and Trestles.

its top and bottom. On both sides of this diaphragm the box would be simultaneously filled with the material to be tested, as sand; thus when the box is full, representing sheet piling driven in sand.

The sand was then to be removed from one side of diaphragm, as would occur when a trench is excavated protected by sheet piling. After the diaphragm had assumed the curve due to the pressure of the sand its curved shape was to be accurately determined and a closely fitting template made to record its curvature.

In order to determine the amount and distribution of the sand pressure, the diaphragm would then be removed from the box and placed horizontally, supported at its ends at the same points it was supported by when vertical in the box. A number of metal strips should be provided, each long enough to reach across the diaphragm, but of varying thickness to make up any required weight, and of equal width. These would be piled at equal intervals on the diaphragm until the curve of flexure is again exactly reached by it which was given it by the sand and recorded by the template; bearing in mind that the tops of the successive piles of metal strips must be on a curve of some uniformity, which may be called the curve of load, without such irregular outline as that of a battlement, and carried over the supports on the line indicated by the curve approaching them. The total pressure, and the center of pressure, would thus be determined, it is thought, with considerable accuracy.

As a check, the flexure curve of the diaphragm already found could be plotted to a convenient scale, and successive differentials taken thereof up to and including the fourth. As the equation of this flexure curve is unknown, the differentiation would be done graphically, remembering that the first differentiation gives the curve of tangents to the flexure curve; the second the curve of moments; the third the curve of shear, and the fourth the curve of load, which should agree with the curve of load determined by the first method—that of weights superimposed on the horizontal plate.

Other materials than sand need testing, such as a heavy semi-fluid mud, and ballast. In each case the angle of repose of the unretained material, and its weight per cubic foot would be noted.

In order to obtain definite conclusions the concrete box and steel diaphragm should be of rather large size; and to prevent the friction of the retained material on the sides of the box from affecting the result materially, narrower steel plates could be placed on each side of the main diaphragm, observations being taken on the main plate only.

The investigation could be extended to determine the pressure on abutments, which are generally filled against gradually on one side only, though this is not part of the work of this Committee. It seems probable that under such mode of filling, the total pressure would be greater, and its center lower, than in the case of sheet piling.

(4) Pile Formulas—F. E. Bissell, Chairman; F. H. Bainbridge, R. D. Coombs and W. F. Steffens, Sub-Committee:

A large number of requests for information were sent out, but the chief matter to be noted from the replies received, was the very small number of roads keeping record of their pile driving in form for use in this investigation.

It seems to the Committee that while a pile driving formula should be based on theoretical considerations, there are so many modifying conditions to be allowed for that the result is a formula more or less empirical in its final make-up.

These modifying conditions can best be noted from actual experience in pile driving; and members are urged, for the advancement of the art, to keep record of the behavior of piles during driving and after loading. Especially is this record valuable in the case of test piles loaded to failure.

(5) Guard Rails—H. Ibsen, Chairman; Prof. H. S. Jacoby, I. L. Simmons and H. Rettinghouse, Sub-Committee:

A large amount of work was done on this subject, replies having been received from members and others representing a mileage of 119,314. These replies were tabulated and considered, but recommendations were not reached for presentation to the Association.

It seems that there are two types of guard rail in use; a guard rail being a member as defined on page 130 of the Manual, Edition of 1911. In one type the two rails are brought together at their ends at the middle of the track; in the other, two similar rails are not brought together at their ends, but remain parallel to the stock rail, and a third rail, also straight, is put in the middle of the track; all three rails in the latter case being deflected at their ends below base of rail.

(6) Fire Protection—I. L. Simmons, Chairman; F. H. Bainbridge, F. E. Bissell, H. Isben and J. A. Lahmer, Sub-Committee:

Replies to a circular letter of inquiry were received from members and others representing 110,214 miles of railway. Of this mileage 62 per cent. when using fire protection adopted either full ballast decks, floors protected by a thin covering of ballast or other like material, or by sheet metal.

The Committee recommended that the same subjects be assigned it for the year 1912 as were assigned for the year 1911, and given in full at the beginning of this report.

The report of this committee was accepted as information.

TIES.

L. A. Downs, Chairman; G. W. Merrell, Vice-Chairman; H. W. Brown, W. J. Burton, L. C. Hartley, E. D. Jackson, F. G. Jonah, H. C. Landon, F. R. Layng, D. O. Lewis, Duncan MacPherson, L. M. Perkins, J. G. Shillinger, G. D. Swingly, D. W. Thrower, H. K. Wicksteed and H. S. Wilgus.

(1) Size of Cross-Ties Required for the Stresses to Which They Are Subjected.

The stresses to which ties are subjected cannot be considered as having no interrelation to the other parts of a roadway. On the contrary, the size of rail, the load above and the bearing beneath the tie, the subsoil, the character of the material between ties, the presence or absence of tieplates, screw versus common spikes, and many other conditions, actual and theoretical, must be considered. It was thought best to obtain from various members opinions along certain lines and for that purpose a set of ques-

tions was prepared by the Sub-Chairman and sent out by the Secretary to all members. Forty replies, representing about 4 per cent. of membership, or 32 per cent. of the mileage represented in the Association, were received. The preparation of the questions and the tabulation of the answers have required considerable time and patience.

The various sizes of ties already in common use, as prepared by the Tie Committee, are tabulated on pp. 771-774, Proceedings for 1905, American Railway Engineering Association. This table has been rearranged in order to tabulate information under the following heads, viz.:

(1) Different number of ties per 30-ft. rail. (See Exhibit B.)

(2) Is a 6x8x8 tie too small; is a larger tie than 6x8x8 undesirable? (See Exhibit C.)

(3) Different sizes of cross-ties in current use. (See Exhibit D.)

A study of Exhibit B shows a preponderance of mileage and membership (42.7 and 38 per cent., respectively) in favor of 16 ties to the 30-ft. rail (2,816 per mile), main track. During the six years intervening the railroads seem to have increased the number, for the general average of a rail-bearing area, as per Exhibit F, is about 40 per cent, whereas in 1905 it ran about 35½ per

L. A. Downs, Chairman Committee on Ties.

cent. Exhibit B, however, indicates that in 1905 17 (2,992 per mile) and 18 (3,168 per mile) ties per 30-ft. rail (bearing area of 38 per cent. and 40 per cent., respectively, based on 8-in. ties) were in strong favor.

Exhibit C was prepared in order to ascertain the feeling as to proper size of cross-ties. It would appear that 59 per cent. of the mileage voting believed a 6x8x8 ft. too small, whereas 96 per cent. thought a larger tie not undesirable.

Exhibit D indicates 22 sizes of cross-ties in current use, with 47 per cent. of the mileage and 48 per cent. of the membership reported as using 6x8x8, whereas that tie is believed unsatisfactory by 59 per cent. (Exhibit C) of the voting mileage and 96 per cent., Exhibit C, believe a larger tie desirable. These tables all show an inconsistency among the railroads as to what they really do desire. There is no doubt that the sentiment is in favor of a larger tie, but the sentiment stage is not overcome.

The length of tie apparently has not been considered so much as width and depth. Exhibit D shows that of 139,029 miles represented, 25,112 miles or 18 per cent. reported ties 8 ft. 6 in. in length. The length of a tie between recognized limits has a great influence on the distribution of its superimposed load over the ballast and consequent tie crushing as well as the amount of maintenance work required with poor ballast, poor subgrade, or both. Ten and three-tenths (10.3) per cent. reported in favor of a 7x9x8 ft. 6 in. and none in favor of a 6x8x8 ft. 6 in. (6x8x8 ft. is the most popular).

A. M. Wellington, in his incomparable treatise on "The Economic Theory of Railway Location," touches admirably on the topic of this Committee in paragraphs 1044 to 1050, inclusive. The extracts from these paragraphs as follows are most apropos:

"1044. The number of these (ties) cannot be too great for economy, until they become so close as to impede tamping, which is when about 40 per cent. of the length of the rail rests upon ties.

"1046. . . . . In endeavoring to get the utmost stability at the least cost the first essential is to use ties as freely as is possible, and the next essential is to decide between a heavier rail and more tamping to supply the deficit.

"1051. . . . . The best dimensions for a tie are about 7 in. thick, 8 ft. 6 in. long and 7 in. to 9 in. face."

The Committee has been unable to find any data in the publications of the Association bearing on the crushing strength across the grain of the various woods used for tie purposes, except that it is lightly touched upon on pp. 853-4, Volume 11, Part 2, Proceedings 1910, American Railway Engineering Association. That table is intended partially to show the effect of preservative treatment on crushing strength at elastic limit and the average of tests for various woods is as follows:

	Natural		Treated		Remarks
	No. of Tests	Crushing at E. L.	No. of Tests	Crushing at E. L.	
Red Oak	4	1090	4	1080	
Loblolly Pine	5	612	5	591	1. Crude oil, 529.
Shortleaf Pine	3	640	3	618	1. Crude oil, 373.
Longleaf Pine	2	688	2	725	
Red Gum	3	830	3	791	1. Crude oil, 655.

Effect of Preservative Treatment on Elastic Limit (Fees).

Note. The natural crushing strength at elastic limit herein given does not compare favorably with similar results obtained by the United States Goverment (see Exhibit G).

The Director of the Forest Products Laboratory, Forestry Service, Madison, Wis., furnished the Sub-Committee blueprints of crushing strength at elastic limit of timber—air dry and green and from which prints Exhibit G is extracted. This table well illustrates why green timber for ties should be shunned.

Bulletin 136, June, 1911, contains an article entitled "Experiment to Determine the Necessary Depth of Stone Ballast," being a report of the General Manager's Committee of the Pennsylvania Railroad. This report is based on spacing of white oak ties 16½ in. face to face for a 7x9x8 ft. 6 in. tie, which tie spacing is equivalent to 25½ in., center to center, or 14 ties per 30 ft. rail, which is equivalent to 35 per cent bearing. That Committee recommended "the use of 24 in. of stone ballast underneath the ties to meet satisfactorily the conditions that exist today and which will become probably more severe as time goes on, and in addition to the 24 in. of trap rock ballast beneath the ties, there should be provided a layer of engine cinders, gravel or an equivalent to act as an absorbent mat to promptly and properly dispose of the water falling on the track in such a manner as to prevent its softening the roadbed material."

Your Committee is of the opinion that further investigation should be made upon these lines to ascertain relation of tie spacing to different depths of ballast.

O. E. Selby, in Bulletin 80, October, 1906, American Railway Engineering Association, treats of the stresses in ties. His recommendation is 12 in. stone ballast directly under tie, superimposed on 12 in. gravel, with ties spaced 20 in. center to center (45 per cent.).

Thos. H. Johnson's formulae for depth of ballast and tie-spacing for gravel and stone ballast appear in Bulletin 76, June, 1906.

It came to the notice of the Sub-Committee that the Erie Division of the Pennsylvania Railroad was experiencing trouble with yellow pine tie splitting; it therefore wrote to R. L. Roe, Division

EXHIBIT B.

DIFFERENT NUMBER OF TIES PER 30-FT. RAIL AND NUMBER OF MILES OF TRACK REPRESENTED UNDER EACH SUCH NUMBER.

Based on Table published on pp. 771-774, Vol. 6, Proceedings, 1905, American Railway Engineering Association.

No. of Ties to 30-ft. Rail, M. T.	Number of Miles	Percentage of Total Mileage Voting	Roads Voting	
			Number	Per cent of those Voting
15	1,634	1.4	12	9.4
16	55,380	42.7	48	38.0
17	17,805	13.8	21	16.7
18	24,190	18.7.	21	16.7
19	4,589	3.6	3	2.4
20	3,949	3.5	3	2.4
14-18	7,180	5.5	2	1.6
15-16	83	—	1	0.8
15-17	154	0.1	1	0.8
15-18	5,984	4.5	1	0.8
15-19	1,416	1.0	1	0.8
16-17	110	0.1	1	0.8
16-18	3,565	2.7	3	2.4
16-19	161	0.1	1	0.8
17-18	3,016	3.0	3	2.4
17-20	153	0.1	1	0.8
18-19	49	0.0	1	0.8
18-21	404	0.3	2	1.6
Total in Membership	129,322	100.0	126	100.0
Per cent of Total	259,384 50	....	990 13	

Engineer, and replies from his Supervisors, W. E. Brown, J. S. Considine, W. S. Wilson, are given, as follows:

"In reply to your circular of the 10th inst., concerning effect of heavy engines on yellow pine ties, would advise that, on that part of the Maryland Division between Baltimore and Perryville, where no engines heavier that D16d were used, yellow pine ties were found equal to oak as far as the wearing qualities were concerned under the 100-lb. rail without tie-plates. This was prior to 1905.

"When I came to this division in July, 1905, I found that a fair percentage of yellow pine ties were used in the main track, some of which had been in service about three years and were all in fair condition. At that time only one class E engine was in service. During the next two years more of this heavier class of engines were used, and in the spring of 1907 we noticed that some of the yellow pine ties which had been in service less than a year were beginning to show signs of crushing. With the increased use of the class E engines the tendency to split seems to grow more pronounced yearly.

"The R. & C. (a light traffic line) has a large percentage of yellow pine ties in track, but fail to notice so marked a tendency in the pine ties to split as on the Renovo Division, in spite of the fact that very few of the branch ties are tie-plated.

"Perhaps this difference may be due to the increased tonnage on the Renovo Division, but the fact that tie-plates are more generally used between West Creek and Strebor should counteract to some extent the heavier traffic and we are inclined to attribute the failure of the yellow pine ties more to excessive axle load on class E engine drivers than to the number of axles which may be hauled over the division."

"Replying to yours of the 10th, regarding effect of heavy engines on pine ties, we find that pine ties without tie-plates become crushed and checked badly under the rail long before they are decayed or otherwise unfitted for service.

"The application of a tie-plate when tie is in this condition will, of course, prolong the life to some extent.

"It is the practice at the present time to use plates on all pine ties when first put in track, and while the greatest amount of service is obtained from the tie by this method, our experience has not been sufficient in this line to say definitely that they will not crush under the heavy concentrated wheel loads where plates are so applied."

"In reply to Mr. H. S. Wilgus' letter of the 8th inst., relative to crushing of yellow pine ties due to the heavy concentrated wheel loads of our heavy engines, it has always been my opinion that if we get good sound yellow pine ties and use tie-plates with them, we will get practically the same life out of them as we get out of the white oak ties.

"Some years ago when track elevation work was done on the P. B. & W. through Chester and Wilmington, one of the main tracks was laid in white oak ties and the other in yellow pine ties. I have been told that a great many of these pine ties are still in track, while a majority of the oak ties have been removed. Pine ties without tie-plates soon split and crush and wear out rather than rot out. We have, however, a great many now in track on this division that were installed about eleven years ago with tie-plates and they are in fair condition considering the service they are giving."

EXHIBIT C.

IS A 6 x 8 x 8 FT. TIE TOO SMALL? IS A LARGER TIE THAN 6 x 8 x 8 FT. UNDESIRABLE?

Based on Table published on page 771, Vol. 6, Proceedings, 1905, American Railway Engineering Association.

	Yes		No		Total Miles appearing in table	Total voting on this point	
	Miles	Per cent of Total	Miles	Per cent		Miles	Per cent
Is 6x8x8 ft. too small	33,936	59	23,678	41	129,322	59,614	45
Is a larger tie than 6x8x8 ft. undesirable	2,220	4	51,755	96	129,322	51,755	40

EXHIBIT D.

DIFFERENT SIZES OF CROSS-TIES IN CURRENT USE.

Based on Table published on page 771, Vol. 6, Proceedings, 1906, American Railway Engineering Association.

Size of Ties	Miles of Road Using Same		Roads Voting	
	Miles	Per cent	Number	Per cent
6 x 7 x 8	222	0.2	2	1.4
6 x 8 x 8	65,432	47.3	67	48.0
6 x 9 x 8	830	0.6	4	2.8
7 x 7 x 8	191	0.1	1	0.7
7 x 7 x 8'6"	6,506	4.7	6	4.2
7 x 8 x 8	13,999	10.1	16	11.2
7 x 8 x 8'6"	2,498	1.8	2	1.4
7 x 9 x 8	5,184	3.7	6	4.3
7 x 9 x 8'6"	14,448	10.3	13	9.2
7 x 9 x 9	8,100	5.8	10	7.0
6 x8-10x 8	4,182	3.0	1	0.7
6-7 x6-12x 8	1,857	1.4	2	1.4
6½ 8x7-11x 8	336	0.2	1	0.7
7 x 7-9x 8	5,459	3.9	2	1.4
7 x9-10x 8	1,440	1.0	1	0.7
8 x 9 x 8'6"	952	0.7	1	0.7
7 x 10 x 8	1,869	1.3	1	0.7
8 x 10 x 8'6"	708	0.5	1	0.7
8 x 8 x 8	3,024	2.2	1	0.7
7 x7-12x 8	163	0.1	1	0.7
7 x7-10x 8	161	0.1	1	0.7
7 x7-14x8'6"	1,468	1.0	1	0.7
	139,029	100		

Conclusions.

So far as your Committee is able to determine it is not feasible to lay down any fixed rule for the size and spacing of ties based on the A, B and C classification of density of traffic, for the following reasons, each of which in itself has a certain definite restriction, as well as an interrelation with all others, viz.:

(1) Character of subgrade varies radically on the same road and in different parts of the country.

(2) Kind of ballast varies widely.

(3) Necessary depth of ballast varies with weight of axle loads, as well as density of traffic.

(4) Necessary distance between face of ties varies with weight of axle load, as well as density of traffic.

(5) Kinds of timber used for ties vary in different sections of the country.

(6) Width of base of rail (or weight of rail) and use of tie-plates.

(7) Treated or untreated ties, crushing stress and durability.

(8) Amount of labor spent on track maintenance.

(9) Drainage.

However, in general it may be considered good practice for Class A and perhaps B roads to space ties 10-in. to 12-in. face to face; the width of tie is not so important if 10-in. to 12-in. spacing face to face is followed; provided, however, the minimum width of face of tie is limited to 7 in.

EXHIBIT G.

Species	Air Dry					Green				
	Compression Vertical to Grain					Compression Vertical to Grain				
	Stress Area, In.	Height, In.	No. of Tests	Per cent Moist.	Cr. Str. of E. L. lbs. per sq. in.	Stress Area, In.	Height, In.	No. of Tests	Per cent Moist.	Cr. Str. of E. L. lbs. per sq. in.
1. Longleaf Pine	4x5	4	22	25.1	572	4x4	4	23	26.3	568*
2. Douglas Fir	4x8	16	44	20.8	723	4x8	16	250	30.3	570
	4x8	10	32	18.1	584					
	4x8	8	51	20.3	636					
	4x4	6	49	24.0	613					
							(Fire	killed)		
3. Shortleaf Pine	4x4	4	29	24.8	603	0x5	16	24	33.7	388
	8x5	16	4	17.8	725	8x5	16	13	37.7	361
	8x5	14	3	16.3	757	8x5	14	13	42.8	366
	8x5	12	5	15.1	730	8x5	12	24	53.0	338
	5x5	8	0	13.0	916	8x5	8	24	47.0	344
	2x3	2	57	13.9	926	8x2	2	277	48.5	450
4 Western Larch						0x8	16	23	43.6	417
						0x8	12	20	40.2	416
						4x6	6	23	53.8	478
						4x4	4	30	50.4	473
5. Loblolly Pine	8x5	16	12	19.8	602	8x4	8	18	67.2	392
	8x5	8	7	22.9	679	4x4	8	33	44.6	548
	4x5	8	8	19.5	713					
6 Tamarack	2x2	2	57	16.2	697					
7 Western Hemlock	7x6	15	25	18.2	514	6x4	6	30	48.7	434
	6x6	6	26	16.8	431					
	4x4	4	6	15.9	488					
8. Redwood						0x8	16	13	86.7	473
						0x8	12	14	83.0	434
						0x7	9	13	74.7	477
						0x6	14	13	73.6	411
						0x2	12	13	66.5	430
						0x2	10	11	55.0	438
						0x2	8	13	58.7	396
						2x3	3	186	75.5	369
9. Norway Pine	2x2	2	36	10	924	2x2	2	43	31.8	310
10. Red Spruce						2x2	2	46	30.4	270
11. White Spruce										

*Partially air dry.

Crushing Strength of Different Timbers.

(2) Tie Renewals in Continuous Stretches Versus Single Tie Renewals.

The Sub-Committee appointed to investigate the comparative merits of "Tie renewals in continuous stretches versus single tie renewals" issued the following letter to the heads of the proper departments of the principal railroads operating in the United States and Canada:

"It is desired to obtain information as to the comparative merits of "Tie renewals in continuous stretches versus single tie renewals." Will you kindly give us your practice and opinion in reply to the following questions:

"(1) What is the practice of your road in renewing ties; tie renewals in continuous stretches or single tie renewals?

"(2) Do you think it advisable to renew ties in continuous stretches?

"(3) What would be the advantage of this latter method of tie renewals?

"(4) What are the advantages or disadvantages of single tie renewals?

"(5) Which practice would you recommend?"

Fifty of these letters were sent out and 35 replies were received. It is noted that all who replied gave the subject the most careful attention, and thereby furnished the committee with some valuable information.

Mr. George W. Kittredge, Chief Engineer, New York Central & Hudson River Railroad:

1. The practice of our road is to renew ties under the method termed "single tie renewals."

2. No.

3. There are no advantages in renewing ties in continuous stretches, except that possibly for the first year or two you might get better track than by renewing singly.

4. The advantages of single tie renewals far outweigh the disadvantages; in fact, I know of no disadvantages. The advantages are:

(1) You are able to let a single tie remain in the track until entirely worn out, since it has the advantage of the ties on each side of it being sound.

(2) The track is always kept safe by having a large proportion of good and comparatively new ties in the track. With continuous renewals there comes a time when, even before the ties are entirely worn out, the track is not safe, and, in order to maintain safety, it is necessary to take the ties out of track before they would, under other conditions, need to be removed, thus shortening their lives.

5. Unhesitatingly I recommend the practice of single tie renewals.

Mr. F. S. Stevens, Engineer Maintenance of Way, Philadelphia & Reading:

1. The practice of our road is to "spot in" or renew only such ties as will not do their work another year on account of being too soft to carry the load.

2. Yes, if the track where ties are to be renewed can be taken out of service while work is being done.

3. Advantages of this method are: That by doing this work without interruption, the labor costs less, by removing the ballast to subgrade and forking it back, dirt is removed and good drainage restored. By retamping on fresh ballast the greatest of trouble is removed, i. e., the constant care of looking after and retamping "spotted in" ties for about two years after being placed in track.

4. The sole advantage of "spotting in" ties where track can be taken out of service while renewals are being made, is that when ties have been taken out of track they are very liable to be wasted or destroyed prematurely. If track cannot be taken out of service to permit tie renewals without interruption, the increased cost of labor to renew "out of face" makes this method prohibitive. Therefore, under these conditions the "spotting in" method is most economical. As far as consistent with economy ties should then be renewed in pairs, as labor costs nearly as much to renew one tie as two. In any event, ballast should be renewed at the same time with ties, as this will make good drainage. This is important, for, unless air can reach the under side of ties, water will, and then trouble begins in earnest.

5. Under the conditions which we generally have to work I recommend the practice of "spotting in." However, when conditions permit I would renew ties "out of face" and would place every tie which will render further service in some track where its remaining life will be used to best advantage.

(A number of additional letters from this report will appear in a later issue.)

Conclusion.

The committee recommends the practice of single tie renewals.

(3) Metal, Composite and Concrete Ties.

Your committee was directed to prepare a report on the use of metal, composite and concrete ties.

During the year the members of the sub-committee dealing with this subject held two meetings—one at Pittsburgh, September 5, 6 and 7, 1911, at which time an inspection of the following ties was made:

Rohm Steel Tie, Sewickley, Pa., Pennsylvania Lines, Northwest System.

Universal Steel Tie, Emsworth, Pa., Pennsylvania Lines, Northwest System.

Reigler Concrete Tie, Emsworth, Pa., Pennsylvania Lines, Northwest System.

Carnegie Steel Tie, Pittsburgh, Pa., Pittsburgh & Lake Erie.

Carnegie Steel Tie, McKees Rocks, Pittsburgh & Lake Erie.

Universal Steel Tie, Pittsburgh, Pittsburgh & Lake Erie.

Atwood Steel and Concrete Tie, McKees Rocks, Pittsburgh & Lake Erie.

Bruckner Concrete Tie, McKees Rocks, Pittsburgh & Lake Erie.

Snyder Steel Tie, Derry, Pa., Pennsylvania Railroad.

Mechling & Smith Tie, Wilkinsburg, Pa., Pennsylvania Railroad.

Carnegie Steel Tie, Port Perry, Pa., Union Railroad.

Carnegie Steel Tie, Homestead, Pa., Carnegie Steel Company.

Carnegie Steel Tie, North Bessemer to Exposition Park, Bessemer & Lake Erie Railroad.

A meeting was also held at Baltimore, Md., November 10, 1911.

In connection with the following report your committee wishes to point out that it is of the opinion that no single design of substitute is going to meet all the conditions to be found on railway track and there should be at least two designs or types:

(1) A tie for heavy service, insulated or not insulated, as required.

(2) A tie for light service, insulated or not insulated, as required.

It is desirable that any type of non-insulated tie should be capable of being insulated without having to be removed from the track.

As far as we can see, very few designers have recognized this distinction and as a result attempt to meet all conditions with a single design. We believe this is neither desirable nor economical, and that much better results will be obtained if the tie be designed for special service.

Your committee has been somewhat disappointed with the results obtained with the concrete tie, the concrete and metal tie, and the asphalt and metal tie, for reasons given in our conclusions.

In regard to steel ties, your committee was impressed with the number of steel ties in use on the Union Railroad and the Bessemer & Lake Erie Railroad. The total number of steel ties on these two roads is over one million, or enough to lay 312 miles of track, using 3,200 ties to the mile.

We desire to call attention to the widespread interest that is now being taken in finding a substitute for the wood tie. This is not confined to any particular section of the country, nor to the steam railroads. The portion of this report covering the street and interurban electric lines is evidence that these lines are seeking a substitute tie.

In addition to the personal inspection made by the committee the following reports have been received from railroads using substitute ties:

Bessemer & Lake Erie Railroad:

(For previous reports see Vol. 10, Part 1, page 496; Vol. 11, Part 2, page 876, and Vol. 12, Part 1, page 371.)

"Up to January 1, 1911, this company had purchased 563,555 Carnegie steel ties and during 1911 we will receice 138,000, making a total of 702,355 ties to be received by January 1, 1912. The ties if laid continuously 3,200 to the mile (our standard spacing on main line) would give 219.5 miles of steel tie track. During the year we also received 20 sets of steel switch ties.

"We have very little, if any, additional information to report this year. The ties put in at Claytonia in 1904 are still in and there has been no change in their condition since our last report. The 1,000 insulated ties installed in June, 1906, at Conneaut, Ohio, are still in and have given no trouble whatever.

"This road will continue to use this type of steel tie in maintenance and construction work.

Buffalo, Rochester & Pittsburgh Railway:

(See previous report, Vol. 12, Part 1, page 371.)

Mr. E. F. Robinson, Chief Engineer, says: "On account of the installation of automatic block signals, we are removing 1,500 Carnegie steel ties from the main track, near Ridgway, Pa. It is our intention to make no further increase in the use of this design of tie, at least for the present."

(A number of additional letters from this report will appear in a later issue.)

Conclusions.

1. The concrete tie, a combination of concrete and metal tie, or a combination of asphalt and metal tie, has not yet proved a success for the following reasons:

(a) Fracture caused by vibration;

(b) Excessive weight and consequent difficulty in handling;

(c) Deterioration of asphalt filling.

2. A combination tie of steel and wood gives promise of developing an economic substitute.

3. The all-steel tie has proved a satisfactory substitute for the wood tie under heavy medium speed traffic. It is durable, line and surface can be maintained, has sufficient resiliency and can be insulated. The fastenings so far in use can and no doubt will be improved.

Discussion on Subject (1).

The chairman made a motion to receive the report on the size and number of ties per rail length.

L. C. Fritch—The committee has left out the question of stresses. This subject is important and I think we should have some information on it. There are a good many who think that the width of tie is important, even if the spacing between ties is made 10 or 12 inches. The conclusions are not definite, except the one as

regards width of ties, and I think the report should be referred back to the committee.

L. A. Downs—The first nine paragraphs given under Conclusions are really only restrictions. The last paragraph is the conclusion the committee agreed on.

L. C. Fritch—We should take into account the track loads and kind of ballast and should design ties accordingly, the same as we do in bridge work. It sems to me that many of us are of the opinion that present ties are too small and are being subjected to excessive stresses.

L. A. Downs—In a bridge you have a solid foundation, which you do not have in track. The materials you deal with in a bridge are uniform, but such is not the case with track and ballast. The track subgrade is a very uncertain quantity.

L. C. Fritch—In designing a bridge or other structure we have to assume certain loads, and I think we should do the same with our track; assume certain loads and conditions of grade and ballast, and then design the track structure.

W. M. Camp—It is impractical to reduce theoretical assumptions of track foundation to a practical basis. I agree with the conclusion if the tie mentioned is understood to be one of standard size.

L. A. Downs—The committee will insert "tie of standard size."

J. L. Campbell—It seems to me if we are able to assume conditions that exist or nearly exist on bridges for the design of the track, that we should be able to assume the approximate conditions for ordinary track, in the same way.

C. A. Morse—It sems to me nothing should be put in the Manual unless it is useful in a practical way. Many conditions are common to a large number of railways, and I think the committee should give us a recommendation based on an investigation of conditions.

C. E. Lindsay—Assuming a stable condition of subgrade and normal conditions, there is a wide range between the maximum spacing—with heavy rail and stone ballast well tamped—and the minimum spacing—depending on methods and tool used for tamping with light rail—and inferior ballast. I believe it is possible to assume a set of conditions and determine what is the best construction.

L. C. Fritch—The railway officials are demanding of the engineers the reasons why larger ties are necessary. I think the committee should investigate stresses set up, and recommend an economical tie.

L. A. Downs—You have only to look at Exhibit F to see the great differences of opinion of different men, and the great variety in practice. This shows how difficult it will be to obtain data which can be used to determine stresses.

W. C. Cushing (President)—The Board of Directors had in mind two subjects when they assigned the work to the committee, (1) to determine what actual practice was, and which the committee has reported on, (2) to study the stresses in ties and, if possible, work out the design of tie which would be most suitable. This part of the subject is in line with the suggestion of Mr. Fritch. The Board has reworded the instructions to the committee, and if agreeable to the Association we would like the report referred back to the committee for further investigation on this phase of the subject.

Foreign engineers have investigated this subject, but more information would be welcome.

Motion to adopt the committee report was lost.

A motion was carried providing that the report submitted be accepted as information, and that the report be referred back to the committee for further consideration.

L. A. Downs—I move the adoption of the conclusion on methods for making tie renewals.

Hunter McDonald—I cannot agree with the conclusion of the committee on this conclusion. I did not receive the committee's circular, and, if I had done so, what I now have to say would be in the report. I do not think it policy to adopt this conclusion just because it is common practice. The report shows opinions only and is not backed up by any comparison of costs of the different methods. In fact, these replies show no deep investigation of the subject. The custom of renewing ties singly has simply grown up because it was the easiest way to do it, and railways have thought it would cost a lot of money to change the system. It is true that expense for ties would be larger until the system was completely installed, but the cost of maintenance would be appreciably less thereafter. The great opposition to renewing ties to face, is that some ties might be thrown away which have a life of 1 or even 2 years if left in the track. I believe that the extra cost of maintaining that tie in the track would more than equal its value. I have found an utter lack of uniformity in keeping costs of maintenance with single tie renewals, and no comparison is possible.

I realize that this problem is a complicated one, depending on life and price of ties, cost of labor, ballast, traffic, subgrade, and standards maintained on the road.

For the past 8 or 10 years one of our roadmasters has kept very careful records of the cost of maintaining stretches of track where the ties have been renewed to face. This roadmaster finally obtained permission to install a mile of experimental track, which was put in in 1908. The rails are 80-lb. A. S. C. E. section. The track has an annual tonnage of 2,000,000, including 10 fast trains. We added 3 inches of ballast, which gave a total depth of 12 inches.

Cost of the Installation.

3,000 white oak ties @ 40c	$1,200.00
1,263 yds. ballast @ 50c	631.50
Labor	844.00
Total per mile	$2,675.50

Cost of Maintenance.

First year	$ 23.00
Second year	29.80
Third year	35.08
Fourth year (estimated)	50.00
Fifth year (estimated)	75.00
Sixth year (estimated)	110.00
Total	$322.88

Average per year, $53.60.

Total cost per annum, $499.66.

We cannot give any comparisons of this cost either with our own or other lines, but hope to do so in the near future. From the best information available I think the following cost is about right, estimated on same basis:

Ties (each year)	$154.00
Labor	77.00
Two inches of ballast every other year	118.00
Labor (ballasting)	250.00
Labor (maintenance)	100.00
Approximately	$700.00

I think that the subsequent cost per mile with renewals to face would be less than the first year.

I think we should have some method of comparing the excellence of our track with some standard. What we need is a simpler method than sending out the dynamometer car.

C. A. Morse—We have installed 22½ miles of track with ties renewed to face, on an experimental section 55 miles long. The sections on this track are divided so as to end at the 22½-mile position. We intend to keep a complete record of this track; 90-lb. rail was laid at the same time, with 12 inches of rock ballast. We estimate a life of 10 years from the ties, which are creosoted, and we also estimate the life of the steel at about 10 years. It has seemed to us that the proper way to carry out this idea is to renew ties and rail at the same time.

W. L. Seddon—I think the ties used in the two cases mentioned were much more uniform than the general run of ties received. In an ordinary shipment of ties there will be some which last only 4 years, others will last 15 years. I think the expense in renewals to face would be much greater than with the ordinary methods.

W. M. Camp—It ought to be possible to get a good comparison between the two methods by comparing the costs on a stretch of newly laid track for several years after its completion.

The conclusion of the committee with respect to the method to use in renewals was put to a vote and adopted.

L. A. Downs—I move the first conclusion of Section III be adopted.

This motion was carried. The Association voted to accept conclusions (2) and (3) as information.

Wm. McNab—I move that the Association tender the committee a vote of thanks and adjourn to attend the Exhibition of the National Railway Appliances Association.

Motion lost.

TRACK.

J. B. Jenkins, Chairman; G. J. Ray, Vice-Chairman; Geo. H. Bremner, A. Bruner, Garrett Davis, Raffe Emerson, E. G. Ericson, J. M. R. Fairbairn, T. H. Hickey, J. R. Leighty, Thomas Maney, Curtiss Millard, P. C. Newbegin, R. M. Pearce, H. T. Porter, W. G. Raymond, S. S. Roberts, L. S. Rose, R. O. Rote, H. R. Safford, F. A. Smith, C. H. Stein, F. S. Stevens, W. J. Towne, R. A. Van Houten.

The subjects assigned were:

(1) Present general specifications covering material and workmanship for frogs, crossings and switches, including the use of manganese and other special alloys.

(2) Present general specifications for track bolts, nut locks, tie plates, common track spikes and screw spikes.

(3) Study designs for main line turnouts.

Frogs, Crossings and Switches.

Your committee has revised the plans for Nos. 8, 11 and 16 Rigid Frogs, No. 11 Spring Frog and for 11-ft., 16½-ft., 22-ft. and 33-ft. switches, and submits them for adoption as general plans representing good practice.

Your committee has also revised and combined the "General Specifications for Frogs, Crossings and Switches," adopted by the convention of 1910, and the "General Instructions for Ordering or Contracting for Frogs, Crossings and Switches," submitted to the convention of 1911 and received as information, and submits them for adoption as representing good practice.

At the convention of 1909, the Association instructed the Track Committee to recommend three standard lengths of switches and three standard numbers of frogs; such a recommendation was made, with the modification that a fourth length of switch was added for special cases requiring frogs of large angle; the recommendation was embodied in Conclusion (4) of your committee's report, which was adopted by the convention of 1910, but was referred back to the committee by the Board of Direction for reconsideration.

Your committee reconsidered and reaffirmed its former action; the conclusion was not resubmitted, however, excepting as the proposed lengths of switches and numbers of frogs were embodied in the "General Instructions for Ordering or Contracting for Frogs, Crossings and Switches," which was received only as information by the Association at the convention of 1911.

In determining the lengths of switches your committee considered it necessary to provide for the following general classes of turnouts:

(a) Turnouts to be operated over the divergent route at the maximum practicable limited speed.

(b) Main line turnouts and crossovers to be operated over the divergent route at low speed.

(c) Yard turnouts.

(d) Turnouts requiring frogs of large angle.

The second point considered was the economical cutting of a 33-ft. rail; the question of using the full 33 ft. as one of the lengths of switch was very fully discussed by your committee at meetings held in three successive years. The main objections to the use of a 33-ft. switch are (1) the length being the same

J. B. Jenkins, Chairman Committee on Ballast.

as that of stock rails unless a special length of stock rail is used, one joint of the latter must necessarily come near the point of the switch and the other joint ahead of and near the heel of the switch, often necessitating the clipping of the angle bars, and (2) the great length of laterally unsupported rail.

Your committee is of the opinion that (1) the location of the joints of the stock rail 40 inches ahead of the point and heel of switch is not seriously objectionable and the clipping of the angle bars is not an expensive operation and does not seriously weaken the joint, and that (2) switches 33 ft. and even 45 ft. long have been successfully used to such an extent that there seems to be little ground for apprehension on account of the length of laterally unsupported rail.

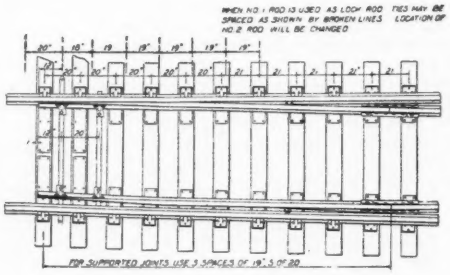
Twenty-seven (27) ft. and 30-ft. lengths have been suggested in lieu of a 33-ft. length; the angles would be respectively 22 per cent and 10 per cent greater than that for 33 ft.

The longest switch points are to be used in those turnouts where the highest speed is desired. These switch points will necessarily get severe usage, therefore they should be made from the very best rail. If made from the second or third rail from the top of the ingot, you have eliminated as far as possible any chance of defect in the rail. These rails are as a rule 33 ft. in length. The lengths of switches recommended can be made from 33-ft. rails without any waste.

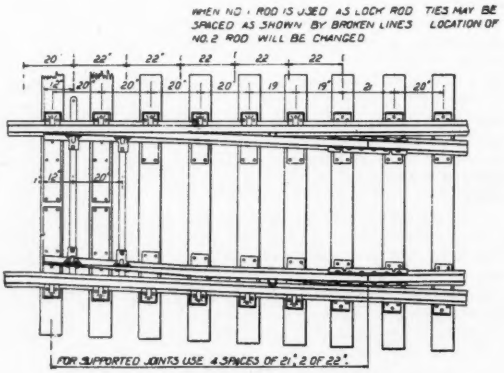
These and other considerations led your comimttee to recommend the following length of switch points for the four general classes of turnouts named above:

(a) 33 ft.; (b) 22 ft.; (c) 16½ ft.; (d) 11 ft.

A purely theoretical investigation of the rate of turning of a locomotive at the switch point and of the angle between the stock rail and a line passing through truck centers of a car leaving the switch, indicates that an approximate balance between



16 6 SWITCH



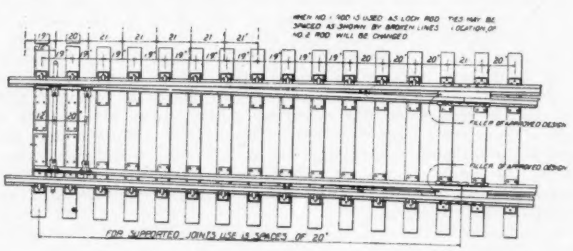
11 SWITCH

the deflection through the switch point and the deflection through the lead is attained when the switch angle equals one-fourth the frog angle. This proportion has been found to work out well in practice. It seems to be certain that when the switch angle exceeds one-fourth the frog angle, the switch point presents the worst feature in the alinement of the turnout and there is an economic loss both in the space occupied by the turnout and in the cost of the turnout.

With a 6¼-in. heel distance and ¼-in. thickness of point, the above relation between switch angle and frog angle would make the length of the switch in feet equal to twice the frog number.

In 1908 the frogs most used appear, from a table compiled by the Engineering News, to have been numbers 10, 7, 8, 9, 6, 15, 12, 20, 11 14 and 16 in the order named; number 10 frogs being used by 55 per cent of the roads tabulated and number 16 by only 5 per cent. But the roads using No. 11's included the Chicago, Burlington & Quincy, Great Northern, Michigan Central and Northern Pacific, and those using No. 16's the Baltimore & Ohio, Erie and Lake Shore & Michigan Southern.

No. 7 frogs are rapidly disappearing, being supplanted by No. 8's;



22 SWITCH

the relative number of No. 10's is also diminishing, with a corresponding increase in the proportion of frogs of higher numbers.

It seems desirable for Class (A) turnouts to use the highest number of frog which is economically consistent with the longest switch point; for Class (B) the great preponderance of present practice is in favor of No. 10 frogs, but the choice of this frog would leave an unfilled gap between this and the highest number frog; besides, a No. 10 turnout with a 16½-ft. switch is little better in its worst feature than a No. 8 turnout with the same switch, while a 22-ft. switch would unduly increase the degree of lead curve; for Class (C) the trend of present practice, if not the preponderance of practice at this date, is in favor of No. 8 frogs; for Class (D) no number of frog can be specified, as this class includes a multitude of special cases.

Your committee presents its former recommendation in a modified form:

16½-ft. switch points are recommended for frogs over No. 6 up to and including No. 10; 22-ft. points for frogs over No. 10 up to and including No. 14; 33-ft. points for frogs over No. 14 and 11-ft. points for No. 6 and under where they are required.

Nos. 8, 11 and 16 frogs are recommended as meeting all general requirements for yards, main track switches and junctions; new work should be laid out, so far as practicable, for these three frogs, so as to effect the gradual elimination of frogs of other numbers, lessen the cost of manufacture and decrease the amount of stock carried.

Tie Plates and Track Fastenings.

No attempt was made to prepare specifications, but your committee attempted to formulate principles as to the functions, material and form of tie plates and track fastenings. The work has not progressed far enough at this time to be embodied in a report.

Designs of Main Line Turnouts.

The work of your committee on this subject is necessarily held in abeyance pending the adoption of standard numbers of frogs and lengths of switches.

Vertical Curves.

In order to get the benefit of experience in the use of vertical curves, a series of questions was asked members of the Association and the replies tabulated.

Under apparently like conditions, widely different results were obtained; this leads to the conclusion that the conditions were only apparently alike and that there must be other unknown conditions. The data in its present form seems to give very little information of value. Your committee will continue its investigations.

Conclusions.

Your committee recommends:

(1) That the "General Specifications for Frogs, Crossings and Switches" be adopted as representing good practice.

(2) That the plans of No. 8, 11 and 16 rigid frogs, No. 11 spring frog and 11 ft., 16½ ft., 22 ft. and 33 ft. switches be adopted as general plans representing good practice.

(3) That the committee's recommendation as to lengths of switches and numbers of frogs be adopted.

GENERAL SPECIFICATIONS FOR FROGS, CROSSINGS AND SWITCHES.

General Instructions.

The company will furnish to the manufacturer specifications and drawings. The drawings will show rail sections, splice drilling, angles, alinement, general dimensions and such details as the company may desire.

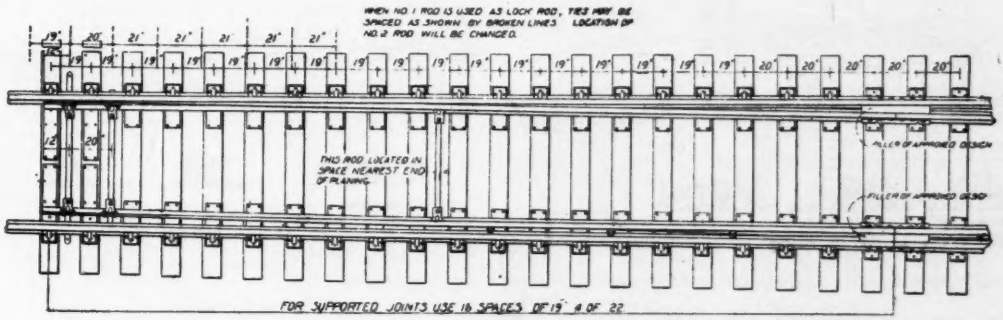
When requested, manufacturers shall submit for approval detail drawings showing construction and dimensions of all parts to be furnished in accordance with these specifications. Conventional shading shall be used in sectional drawings. All dimensions and distances shall be shown plainly in figures. The title shall be placed in the lower right-hand corner.

The detail drawings shall be on sheets twenty-two (22) in. wide, with a border line one-half (½) in. from the top, bottom and right-hand edge, and one and one-half (1½) in. from the left-hand edge. The standard length of sheets shall be thirty (30) in., except that when necessary longer sheets may be used and folded back to the standard length. Drawings of one subject only shall appear on a sheet. Scale of general drawings shall be 1½ in. = 1 ft.; details not less than 3 in. = 1 ft.

The drawings of the company and the manufacturers' drawings approved by the company shall be a part of the specifications. Anything which is not shown on the drawings but which is mentioned in the specifications, or vice versa, or anything not expressly set forth in either but which is reasonably implied, shall be furnished the same as if specifically shown and mentioned in both. Should anything be omitted from the drawings or specifications that is necessary for a clear understanding of the work or should any error appear in either the drawings or specifications affecting the work, it shall be the duty of the manufacturer to notify the company and he shall not proceed with the work until instructed to do so by the company.

Inspection.

Material and workmanship shall be at all times subject to inspection by a duly authorized representative of the company, who will examine the material before it is worked in the shop. He will inspect the work during progress and will also inspect the finished product, with power to reject materials and workmanship found to be unsatisfactory. He shall have free access to the shops and mills at any and all times during the progress of the work.


WHEN NO. 1 ROD IS USED AS LOCK ROD, TIES MAY BE SPACED AS SHOWN BY BROKEN LINES. LOCATION OF NO. 2 ROD WILL BE CHANGED.
THIS ROD LOCATED IN SPACE NEAREST END OF PLANING.
FILLER OF APPROVED DESIGN
FILLER OF APPROVED DESIGN
FOR SUPPORTED JOINTS USE 16 SPACES OF 19" & OF 22"

33 SWITCH

The acceptance of any material by an inspector shall not prevent subsequent rejection if found defective after delivery or during the progress of the work, and such defective material if furnished by the manufacturer shall be replaced by him at his own expense.

All facilities, labor and tools necessary for the shop inspection shall be furnished at the expense of the manufacturer.

When the manufacturer furnishes the rails, he shall supply the company with a certificate of inspection made by some competent person acceptable to the company.

Material.

Rail.

No. 1 rail, of the section ordered, as called for by the specifications, shall be used.

Fillers.

Fillers between the main and wing rails and between the main and easer rails shall be rolled steel. Throat filler blocks, not presenting a running surface, may be cast iron.

Raiser Blocks.

Raiser blocks shall be hard cast steel.

Foot Guards.

Metallic foot guards shall be either cast iron, malleable iron or cast steel, except that strap foot guards shall be rolled steel. Wooden foot guards shall be of best quality hard wood.

Bolts.

Bolts shall be of double refined iron or mild steel. Bolt metal shall have a tensile strength of not less than 50,000 lbs. per sq. in. and an elongation of not less than 15 per cent in eight inches. When nicked and then broken, the fracture shall be free from flaws and unwelded seams.

Rivets.

Rivets shall be made of steel which may contain a maximum of 0.04 per cent basic phosphorus, 0.04 per cent acid phosphorus, and 0.04 per cent sulphur. It shall have an ultimate tensile strength

of 50,000 lbs. per sq. in. It shall bend flat upon itself without fracture and when nicked and bent around a bar of the same diameter as the rivet rod it shall give a gradual break with a fine silky uniform fracture.

Reinforcing Bars.

Reinforcing bars shall be of wrought-iron or mild steel.

Plates.

Plates shall be of rolled steel.

Springs.

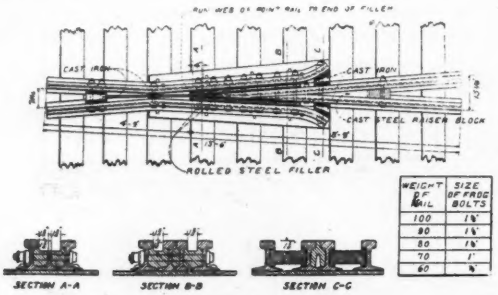
Springs shall be of the best quality spring steel and of dimensions and capacity shown on the plans. They shall meet the following tests:

(a) Each spring shall be placed on the testing machine and forced down solid four times.

(b) After the foregoing, each spring shall be placed on end on a flat plate, and the distance between the plate and the other end of the spring measured by means of the standard depth gauge; this measurement being the free length of the spring. The free length must conform to the plans within 1/8 in.

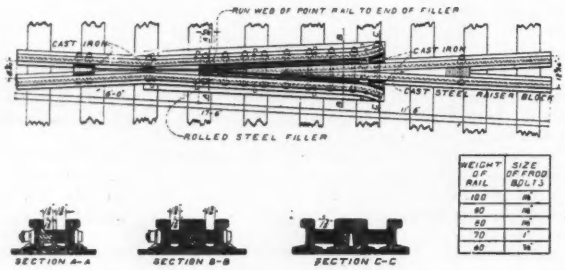
(c) Double springs shall be assembled and a load at least 25 per cent greater than the rated capacity of the spring shall be applied for thirty seconds. Upon release neither spring must vary from its original free length. If either one does so vary, it shall be rejected.

(d) The inner and outer coils of springs shall be coiled in opposite directions.



WEIGHT OF RAIL	SIZE OF FROG BOLTS
100	1⅛
90	1⅛
80	1⅛
70	1
60	⅞

NO. 8 RIGID FROG



WEIGHT OF RAIL	SIZE OF FROG BOLTS
100	1⅛
90	1⅛
80	1⅛
70	1
60	⅞

NO. 11 RIGID FROG

Spring Covers.

Spring covers shall be made of malleable iron.

Braces.

Braces shall be made of malleable iron. forged steel.

Stops and Hold-downs.

Stops and hold-downs shall be made of mild steel.

Anti-creeping Device.

Anti-creeping device shall be made of mild steel.

Switch Lugs.

Switch lugs shall be mild steel.

Switch Rods.

Switch rods shall be mild steel.

Workmanship.

Workmanship shall be first-class. All bends shall be made accurately in arcs of circles and without injury to the material. Welding will not be permitted in any part of the frogs or in the switch rails. Planing shall be such that abutting surfaces will fit accurately together. Ends of rails shall be cut at right angles to the axis of the rail except where otherwise specified. All burrs shall be removed.

No paint, tar or other covering shall be used before inspection.

The alinement and surface of all finished work shall be even and true, and shall conform to the angles specified.

Frogs.

Rolled fillers shall fit the fishing angles and the web of the rail for a distance of ½-in. above and below the base and head, respectively, and shall maintain the required flangeway. Throat filler blocks shall fit the rail sufficiently well to maintain the required spacing. Where the brand of the rail interferes with the fit of the filler the brand shall be chipped off. Fillers shall be grooved or cut out to fit over rivet heads.

Heel Raiser Blocks.

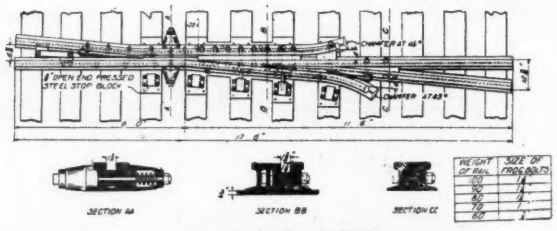
Heel raiser-blocks shall fit the head, base and web of rail as provided under rolled fillers.

Foot Guards.

Solid Foot Guards shall fit the rail sufficiently well to maintain the required spacing. Strap guards shall have a minimum thickness of ⅜-in. of the width shown on plan, and shall be fastened to the web of the rail by bolts or rivets not less than ¾-in. in diameter.

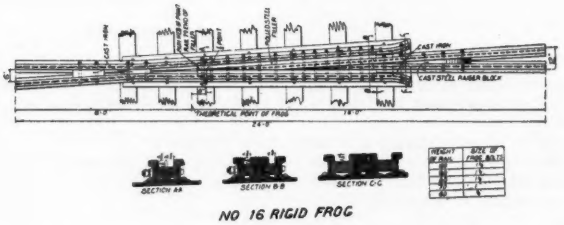
Bolts.

Bolts must be round and true to size, with square heads and nuts. Threads must be accurately cut and nuts must have a wrench-tight fit. Each bolt must be provided with an approved head lock and a nut lock of approved pattern large enough to give full bearing for the nut. A ¼-in. cotter pin shall, when required, be placed outside of and close up to the nut after it is tightened. Beveled washers must be used wherever necessary to give the head and nut a full, square bearing. Separate head lock shall be of material not less than 3/16-in. thick. Washers



WEIGHT OF RAIL	SIZE OF FROG BOLTS
100	1⅛
90	1⅛
80	1⅛
70	1
60	⅞

NO. 11 SPRING FROG



WEIGHT OF RAIL	SIZE OF FROG BOLTS
100	1⅛
90	1⅛
80	1⅛
70	1
60	⅞

NO 16 RIGID FROG

used under heads may be of such design as to act as head locks. Bolts must be long enough to allow the nuts to be brought out from under the head of the rail, with a suitable washer not less than ½-in. thick, so that the nuts may be readily tightened with an ordinary wrench.

Rivets.

The diameters of the rivets shall be of full size shown on plan, and the diameters of the rivet holes shall not be more than 1/16-in. greater than the diameters of the corresponding rivets. The rivets shall be of sufficient length to provide full, neatly made heads when driven. They shall be driven tight, bringing all adjacent parts into contact.

Rivets, when not countersunk or flattened, shall have standard button heads of uniform size for the same size rivets. The heads shall be full and neatly made and concentric with the holes. When the rivet heads are countersunk they shall be flush with the plate and fill the holes.

Reinforcing Bars.

Reinforcing bars shall fit the fishing angles and web of rail throughout their length.

Plates.

Plates shall be flat and true to surface.

Springs.

Springs shall have the ends square with the axis, so that when the spring is placed on end on a flat surface it will stand perpendicular thereto.

Spring Covers.

Spring covers shall be of such dimension as to permit a proper

working of the springs and shall be provided with a spring bearing for each end of the spring.

Braces.

Braces shall fit the head and web of rail accurately.

Stops and Hold-downs.

Stops shall be so placed on plates as to hold the wing rail at 1⅞-in. opening at the ½-in. point. Hold-downs shall fit stops so as to allow at least 2 in. horizontal play and not more than ⅛-in. vertical play.

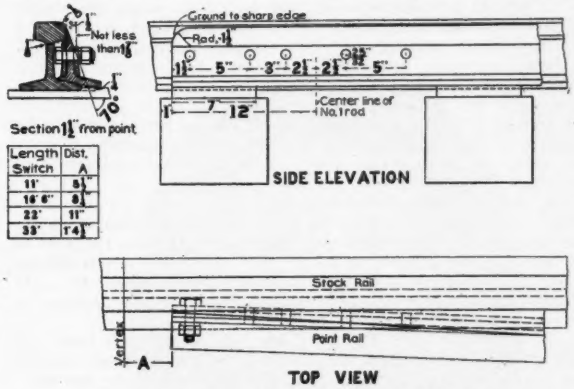
Anti-creeping Device.

The anti-creeping device shall fit accurately to the parts of the frog or angle bars.

Holes for the Main Bolts.

Holes shall be drilled from the solid. No punching will be permitted except of bottom plates and washers. Drilling shall be accurately done, on bevel where necessary, and holes shall be made $\frac{1}{32}$-in. less in diameter than the bolt to be used. Then the parts shall be assembled and the holes reamed so they are straight and true, with no offsets between the adjacent parts, and of such size as to give the bolts a driving fit for their entire length.

In lieu of the above specification for drilling and reaming, the manufacturer may assemble and accurately fit all the parts, before any drilling whatever is done; after the parts are securely clamped in their correct positions the holes may be drilled of



Length Switch	Dist. A
11'	5'
16' 6"	9'
22'	11"
33'	1'4"

Details of Proposed Standard Switch Point.

such a size as to give the bolts a driving fit for their entire length.

The number of the frog, maker's name, weight of rail and the date shall be plainly stamped with ¾-in. figures and letters on the flare of one wing rail for rigid frogs and the flare of both wing rails for spring frogs, or a plate shall be fastened to the frog with the same information.

Switches.

Throw.

5 in. at center line of No. 1 rod.

Gage of Track.

4 ft. 8½ in.

Switch Rails.

Side planing and bending of switch rails shall conform to a spread at the heel of 6¼ in. between the gage lines of the stock rail and the switch rail and a thickness of ¼-in. at the point. The bending and planing shall be done so as to give a straight gage line to the switch rail. The switch rail shall afterward be ground down to a thickness of ⅛-in. at the point, beginning 2 ft. back from the point of the switch; the point of the switch shall then be ground down to a sharp edge with a radius of 1½ in. The head of switch rail shall fit neatly against the head of stock rail from point of switch rail to point of divergence. The inner edge of the head of the stock rail and the outer face of the web of the switch rail at the point shall be in the same vertical line when the switch rail is fitted against the stock rail.

Top planing shall conform to the measurements shown in figure and Table 1.

Table 1.

Switch.	A. B.
33 ft.	12 ft.
22 ft.	9 ft.
16 ft. 6 in.	5 ft.
11 ft.	5 ft.

Bottom of switch rail shall be planed to fit neatly on base of stock rail where bases overlap.

The point of switch rail shall be as shown by Fig. 2.

Holes for switch rod lugs and stop blocks shall be $\frac{13}{16}$-in. in diameter and 5 in. center to center. Holes for reinforcing bars shall be $\frac{13}{16}$-in. diameter. Number and location as provided under Reinforcing Bars.

Lugs.

Lugs shall be as deep as the section of rail will permit.

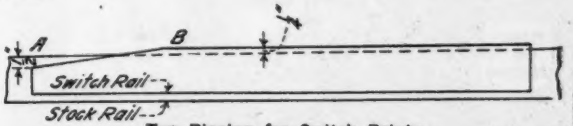
Distance between centers of holes for bolts running through the web of the rail shall be 5 in. Diameter of holes shall be $\frac{13}{16}$-in. Switch rod bolt hole shall be $1\frac{3}{16}$-in. in diameter.

Switch Rods.

Switch rods shall be ¾x2½ in. and shall be held in a horizontal plane. Bolt holes shall be $1\frac{3}{16}$ in. in diameter. There shall be at least 1½ in. of metal at end beyond bolt holes.

Reinforcing Bars.

A reinforcing bar ⅝-in. thick shall be riveted to each side of each switch rail and point ends shall be made flush with point of switch rail. The bars shall be as long as the heel connections will permit. Bars shall fit against web of rail and shall fill the space between head and flange of rail. There shall be ½-in. clearance between outer bar and head of stock rail where the bar projects under the head of stock rail. Top of inner bar, where it projects beyond the head of switch rail, shall not be less than 1⅞ in. below the top of stock rail. The reinforcing bar shall be beveled to an angle of 45 degrees where it projects beyond the head of the rail.

Bars shall be fastened to rail with ¾-in. rivets, except that at bolts, the first, second and fifth holes, and the holes through which the lugs are fastened, they shall be bolted. Center of first hole shall be 1½ in. from point and center of last hole in bar shall be 2 in. from heel end of bar. Intermediate rivets, bolts, shall be spaced so that there shall be fastenings at intervals not greater than 12 in.

Top Planing for Switch Points.

Stop Blocks.

Stop blocks shall be of approved design with holes $\frac{13}{16}$-in. in diameter. Stop blocks shall be placed as nearly as practicable at equal intervals between the end of planing and heel of switch.

Heel Blocks.

Heel blocks shall be of approved design with standard rail drilling.

Bolts and Nuts.

Bolts, fastening lugs, stop blocks and foot guards to switch rails shall be ¾-in. in diameter. Bolts connecting the lugs with switch rods and the switch-stand connecting bolt shall be 1 in. in diameter and machine turned. All bolts shall be provided with nut locks and cotters. ¾-in. bolts shall have hexagonal nuts and 1 in. bolts shall have square nuts.

Rivets.

The diameters of the rivets shall be of full size shown on plan, and the diameters of the rivet holes shall not be more than $\frac{1}{16}$-in. greater than the diameters of the corresponding rivets. The rivets shall be of sufficient length to provide full, neatly made heads when driven. They shall be driven tight, bringing all adjacent parts into contact.

Rivets, when not countersunk or flattened, shall have standard button heads of uniform size for the same size rivets. The heads shall be full and neatly made and concentric with the holes.

When the rivet heads are countersunk they shall be flush with the plate and fill the holes.

Plates.

There shall be on each tie two plates of suitable length ⅞-in. by 7 in., planed down to receive the stock rail and braces. Three holes outside and two inside are required for ⅞-in. lag screws or screw spikes, or for ordinary spikes, as may be specified, on all switch ties, except the two head ties, where there shall be three outside and five inside, one of the inside holes to be in position for spiking the switch.

Braces.

Braces shall be of such a design that 2½ in. clearance for detector bars may be obtained. Three holes for ⅞-in. lag screws or screw spikes shall be provided.

Foot Guards.

Strap foot guards shall have a minimum thickness of ⅜-in. and shall be fastened to the web of the rail by ¾-in. bolts or rivets.

Note.—The following members of the Committee approve the report as submitted herewith: J. B. Jenkins, Chairman; L. S. Rose, Garrett Davis, J. R. Leighty, Curtiss Millard, T. H. Hickey, Raffe Emerson, J. M. R. Fairbairn, H. T. Porter, P. C. Newbegin, W. G. Raymond, S. S. Roberts, F. A. Smith, R. A. Van

Houten, W. J. Towne, H. R. Safford, R. M. Pearce, C. H. Stein, Thos. Maney.

The following members of the Committee approve the report conditionally; G. J. Ray, A. Bruner, F. S. Stevens.

The following members dissent from portions of the report: Geo. H. Bremner, R. O. Rote.

Discussion.

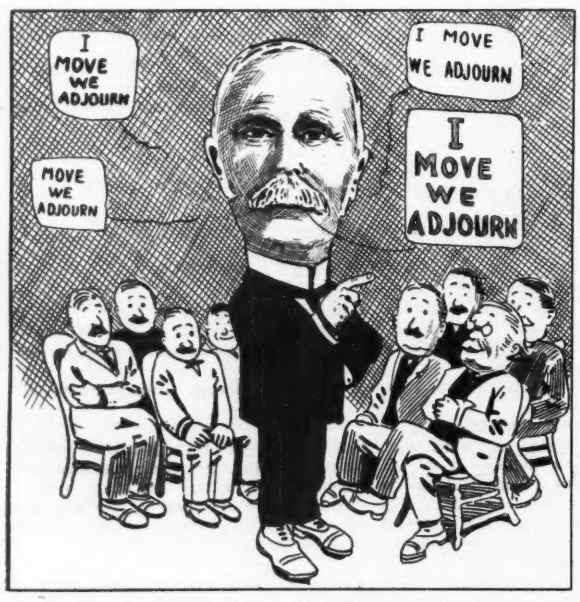
J. B. Jenkins: At the request of the President I move that conclusion No. 2 be adopted as general plans representing good practice. This has no bearing on conclusion No. 3.

The motion to adopt No. 2 was carried.

J. L. Campbell: With respect to the 33-ft. split switch, I would like to inquire if the Committee came to a decision on the location of the main line joint. I would also like to know if the committee has considered the question of having special lengths of lead rails cut at the mills.

J. B. Jenkins: We considered both of those questions. A 60-ft. stock rail would eliminate all trouble with the joint in the main line. However, we do not consider that the 33-ft. stock rail gives a bad joint if located about 40 ins. ahead of the heel of switch, and the angle bar sheared. In answer to another question which was raised, would say that the plans show the fillers must be of approved design.

C. E. Lindsay: On the switch point plans the front hole for the



Anxious to See the Track Appliances Exhibit.

head rod is located 1½ ins. from the point. I understand this is for the convenience of the signal men, and allows them to install a modern type front rod used in the interlocking. This design calls for the alternate plan for spacing ties submitted. I think this latter spacing is all that is necessary, provided it is safe to allow the point to project about a foot ahead of the No. 1 rod. I think we could discard the other plan. I think it would eliminate a good deal of spacing of ties, due to spacing ties when interlocking is installed at a later time.

J. B. Jenkins: We do not think all roads could use that design, and so we have submitted both. If any railway wishes to, they can adopt that design exclusively.

An objection was made to the 5½ ins. clearance required at switch points, and the opinion expressed 4½ ins. was ample. The chairman explained that 5½-in. clearance was necessary because the switch point lags.

Conclusion No. 2 was put to a vote and adopted.

J. B. Jenkins: We have submitted only three frogs and three lengths of switches, because we were instructed to do so by the board. In the longest turnouts we want the very best rail and so chose a 33-ft. point; this length cannot be made from a short length, possibly of inferior quality. Our committee wishes definite action, either adoption or rejection with further instructions. Our idea is that the frogs as recommended are to be used in new work only. No change would be made, of course, in existing track.

L. C. Fritch: I think this report is acceptable, if it is understood that we only need use it in new work.

George W. Kittredge: I am not entirely satisfied with reasons for adopting the No. 11 rather than the No. 10 frog.

J. B. Jenkins: The 33-ft. rails, with a 22-ft. switch rail, are most easily adapted to a No. 11 turnout.

C. A. Morse: I favor the report for the reason that we need a common standard.

L. C. Fritch: I suggest that we consider the conclusion in two separate parts, (1) number of frogs; (2) length of switch.

J. B. Jenkins: That is satisfactory to the committee, and I move that the recommendation with respect to frogs be adopted.

Geo. W. Kittredge: We have already adopted the plans for frogs, and I think it would be inconsistent not to accept the recommendation with respect to lengths.

W. C. Cushing (President): In adopting the plans, we did not adopt the numbers.

The motion to adopt No. 8, 11 and 16 frogs was passed.

L. C. Fritch: I move we amend the committee report to specify 26½-ft. instead of 33-ft. points.

J. B. Jenkins: The committee does not believe a 26½-ft. point gives a small enough angle, and they want the switch rail to be made from a whole rail.

H. T. Porter: Several years ago the association voted to use as long a switch rail as possible. Considering all phases of the subject, a 33-ft. switch rail is best, because then we can specify from which portion of the ingot the rail is to be from. A 26-ft. point is liable to be made from a short rail. It was also desired to get the smallest angle possible, in order that the highest number frog could be used with a curve giving the same effect with respect to change in direction, as the switch point. In France a 39 ft. 6 in. point is being used with excellent results. To sum up, we think the 33-ft. switch rail gives the best quality of steel, lightest curve, and the point gives the same deflection as the curve for a No. 16 frog.

In answer to a question J. B. Jenkins stated that the dissenting members of the committee did not agree on the number of frogs and length of switch rails. The letters of these members were then read.

J. B. Berry: I think this association should have all the information it can get before deciding this question, especially since the report is to be printed in the manual. Thirty-five per cent of the railways use a No. 10 frog. I don't see that the advantages of a No. 11 frog are sufficient to justify the change. It would increase the number of stores necessary for such a railway to carry.

J. B. Jenkins: The idea in having only three frogs is to cut down the stores. We think we have the best three. These designs give rapid traffic through junctions, which is much to be desired.

Geo. H. Bremner: I think the committee is to be congratulated in getting as nearly a unanimous report as they did. In fact the committee are agreed that the report is *good*, but some think it is not the best practice. It is questionable whether the three frogs will fulfill all conditions. I think a combination could be found that would not change so many of our standards. Those proposed would change the standards of practically all of the railways. Standards are constantly changing in favor of sharper frogs. The switch rails submitted are good, but not the best practice. German railways use larger switch rails than 33-ft. The question is still open, I think, but believe we can accept the report as good, but not as recommended practice.

L. C. Fritch: I think the recommendation should be changed to read "In yard work a No. 8 is recommended. In main line a No. 10 or No. 11 is recommended for medium speeds. For high speed main line switches, a No. 15, 16 or even higher is good practice." However, the committee was instructed to report only three. I do not think we will ever be able to agree on three only.

The amendment to change the length of the 33-ft. point to 26½-ft. was lost.

The committee's report for lengths of switch rail was voted on and passed.

J. B. Jenkins: I move that conclusion (1) be printed in the Manual, together with figures 1, 2, 381 and 382.

Motion carried.

F. G. Bacheider: I suggest that we insert a clause respecting foot guards as follows: "Foot guard shall conform to state laws."

This motion was lost.

C. E. Lindsay: I move that the length of planing switch rails given in the table be changed from 5 to 7 ft.

Motion carried.

YARDS AND TERMINALS.

C. H. Spencer, Chairman; E. B. Temple, Vice-Chairman; Hadley Baldwin, W. C. Barrett, M. S. Blaiklock, G. H. Burgess, A. E. Clift, A. L. Davis, H. T. Douglas, Jr., A. C. Everham, D. B. Johnston, H. A. Lane, L. J. McIntyre, B. H. Mann, A. Montzheimer, W. L. Seddon, A. Swartz, J. E. Taussig, E. E. R. Tratman, W. L. Webb, J. G. Wishart.

The Board of Direction assigned the following subjects:

(1) Report on typical situation plans of passenger stations, of both through and stub types, with critical analyses of working

capacity, and include a review of the different methods of estimating their capacity.

(2) Report on developments in the handling of freight by mechanical means.

(3) Report on developments in the design and operation of hump yards.

(4) Report on typical situation plans for a division engine terminal.

(5) Report on methods of handling baggage, express and mail, at passenger terminals.

The committee was also instructed to consider revision of Manual; if no changes were recommended, to make statement accordingly, and to make concise recommendations for next year's work.

Revision of Manual.

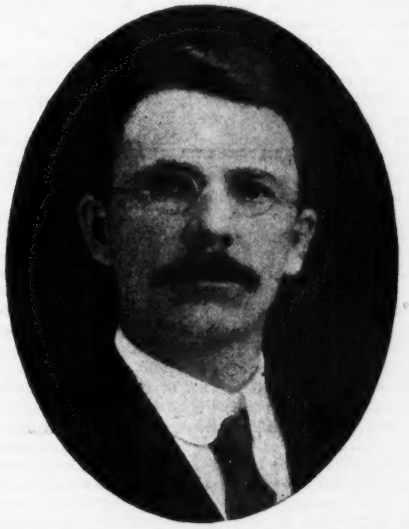
After careful consideration of the present Manual, the committee has no recommendation for further changes at the present time.

(1) Typical Situation Plans of Passenger Stations.

The sub-committee has accumulated a large amount of data with respect to existing terminals. The subject assigned, however, is so broad and important that it is desirable to continue work on it through another year. In view, therefore, of the expressed desire of the Board of Direction that the reports be limited as far as possible, it was decided to reserve report on this subject until next year.

(2) Handling of Freight by Mechanical Means.

Considerable progress has been made at different points in the development of freight handling by mechanical means since the committee's last report, and during the past year inspection was made of the new Missouri, Kansas & Texas freight handling plant at Broadway station, St. Louis, Mo., the Baltimore & Ohio telpher system at Pier No. 8, Locust Point, Baltimore, Md., the power conveyor system in one of the new warehouses of the Texas City Transportation Company, at Galveston, Texas, and of the electric truck system at Dock No. 6, Jersey City, N. J. As nearly all of these systems are practically new and sufficient time has not elapsed since installation to enable all points as to their utility to be definitely determined, both as to economy of operation and practical utility, full report on these systems is held over for future publication.



C. H. Spencer, Chairman Yards and Terminals.

(3) Design and Operation of Hump Yards.

Additional data on existing hump yards has been secured by the sub-committee and is held for future report.

(4) Typical Situation Plans for Division Engine Terminal.

In treating this subject, the committee understands its work to be the making of recommendations as to the best arrangement of facilities for the handling of locomotives at terminals rather than as to specifications for exact designs of the various structures involved, excepting as in a general way the characteristics of such structures seem to be more or less suited to the arrangement recommended.

It is also understood that the scope of the committee's work does not include the consideration of shop or repair yard locations.

We submit herewith a typical plan or layout for an engine terminal whose characteristics permit of application equally well to larger or smaller demands practically without limit and without respect to whether the locomotives cared for are all freight or passenger, or in both kinds of service.

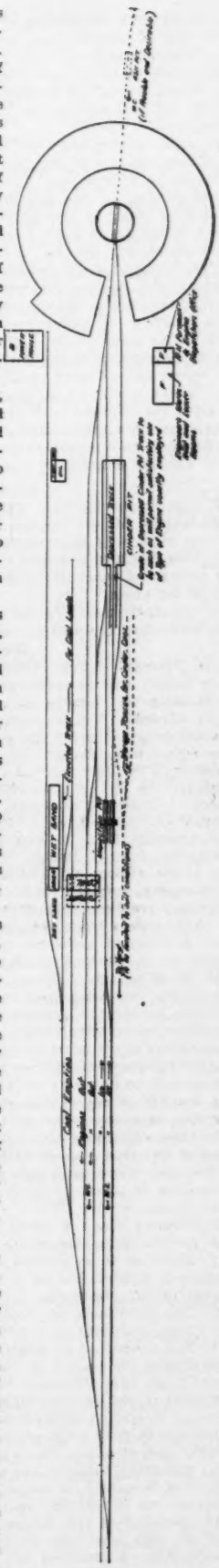
We have examined a number of plans of recently constructed engine terminals, and think we have adopted in our plan the best ideas of all, and that we have avoided the manifest errors of some at least of these plans. It must, of course, be recognized that in any case of actual construction, physical limitations as to space and shape of the ground site will impose more or less modification of the plan we recommend, but we think it will come more generally within the possibility of any given set of conditions than any other typical plan that could be suggested.

In locating an engine terminal, the facilities should be placed with reference to the yards and main line in the most advantageous position possible, that is, so that the distance between the engine terminal and the points where engines begin and end their service shall be a minimum, and so that reverse or conflicting movements shall be avoided as much as practicable.

The idea to be kept in mind is the most direct and convenient, that is, rapid and economical performance of those things required for an engine in its terminal in that sequence which answers all requirements in the order of their urgency. It appears to us that on the arrival of a locomotive at its terminal, the first imperative demand is likely to be for water, and that this demand is likely to be the last when leaving the terminal for service, and for this reason our typical plan provides for the location of watering facilities accordingly.

After an incoming engine has been protected by receiving water, the next step appears logically to clean its fires or remove it entirely, according to need, and place the engine as quickly as possible in the engine house, where the repairs necessary to prepare it for new service may be made, engine cleaned, etc. The cinder pit should be located as close as practicable to the engine house and permit at the same time of engines moving off cinder pit in normal direction, being switched direct to an outbound track without using or fouling turntable, as may often be desired.

It appears logical that the process of coaling should be reserved, if practicable, until just before the engine re-enters service in order that it may do so with a maximum supply of fuel, and also because the cleaning or removal of fire on cinder pit, as well as repairs of engine tank or other repairs, can be accomplished without that interference that might result from having tender filled with coal, and this reasoning dictates that the location of the coaling station should be primarily to serve the outbound tracks. Inasmuch, however, as it may often occur that incoming engines



Plan of Engine Terminal.

will require coal, the coaling station should be located as indicated on our typical plan, so that coal may also be taken by an engine on an inbound track.

The trestle type of coal dock may be used if desired, if only two coaling tracks are required, and can be located between the inbound and outbound tracks in same relative position as shown in typical plan.

The most convenient and economical arrangement for storing and drying sand is at the coal station, where it may be handled by the same attendants. Sand should ordinarily be delivered to engines passing on the inbound tracks.

It will be observed that the arrangement of facilities permits of large increase in capacity of cinder pit, coaling station, etc., and in this connection the idea of having the coaling station at a busy terminal comprising two independent units makes a strong appeal for approval in view of the possibility of one of the hoisting plants suffering temporary disability from breakdown, or other cause.

The location of storehouse, oil house, enginemen's tool and locker rooms need not be arbitrarily prescribed, but should be as close as practicable to the engine house and the cinder pit. However, where any of these buildings are served by their own tracks, those tracks should be so located and connected as not to interfere with the uninterrupted free use of the engine tracks.

A system of ample lighting facilities is important, with lights distributed so as to avoid, as far as practicable, darkness or shadow where men are engaged in work upon engines.

Conclusions.

(1) The engine terminal should be so located as to afford easy access to both Main Line and Yards, with the fewest possible reverse or conflicting movements.

(2) The facilities provided should be arranged to permit of the most direct and rapid handling of an engine in its terminal in the order of its needs.

The committee recommended for next year's work a continuation of Subjects Nos. 1, 2 and 3, enumerated above.

Discussion.

C. H. Spencer: I move that conclusion No. 1 be adopted.

This motion was seconded and passed.

C. H. Spencer: I move that conclusion No. 2 be adopted

C. E. Lindsay: I agree with this conclusion except that it does not state in which order the conditions shall be met.

The report was adopted.

RAIL.

Chas. S. Churchill, chairman, R. Montfort, vice-chairman, E. B. Ashby, J. A. Atwood, A. S. Baldwin, J. B. Berry, M. L. Myers, W. C. Cushing, F. A. Delano, P. H. Dudley, C. H. Ewing, C. W. Huntington, John D. Isaacs, Thos. H. Johnson, Howard G. Kelley, C. A. Morse, George W. Kittredge, J. T. Richards, J. P. Snow, A. W. Thompson, Robert Trimble, M. H. Wickhorst.

Reports have been submitted during the year, as a part of the Rail Committee's work, as follows:

(A) A Study of Seventeen Good Service Rails, by Robert Trimble and W. C. Cushing (Bulletin No. 135, May, 1911), with notes by M. H. Wickhorst. These rails contained carbon within or a little above the usual limit for 85-lb. rails, namely, 0.45 to 0.55. With this carbon the phosphorus was close to 0.10 or above, the manganese was mostly within the usual limits of 0.80 to 1.10. Some of the rails were of fairly uniform composition throughout the section, but others were more or less segregated. This study did not perhaps lead to any very definite results, but indicates that under some conditions segregated rails high in phosphorus, and possibly also in carbon, may give long service, although it does not define these conditions either of track or material.

(B and C) Rail Failure Statistics for the Year Ending October 31, 1910, and Segregation and Other Rail Properties as Influenced by the Size of Ingot, by M. H. Wickhorst (Bulletin No. 137, July, 1911).

Mr. Cushing made a study of the Rail Failure Statistics and below are his comments on the subject:

(1) Study of these general statistics does not furnish accurate and specific information so as to determine the value of different sections of rail, because:

(a) The conditions of traffic are different.

(b) The conditions of roadbed are different.

(c) The conditions of ingot making and rolling practice are so different that the quality of the material varies widely, and, at the present time, this difference in quality of the material eliminates differences in section; nevertheless, when the time comes that the difference in quality of material will be less, the influence of the section will be more apparent, for there is no doubt that one section is stiffer and stronger than another according to the distribution of the material. Inasmuch as we are endeavoring to eliminate the differences in quality of material and bring it to a high state of perfection, we should not, in the meantime, lose sight of the desirable features of the rail section, but keep them constantly in mind, so that when we arrive at a good quality of metal, we will also have a desirable rail section.

(2) A study of these general statistics tends to disclose unusual results, and were it not for their compilation, we would not have much information relative to the difference between Bessemer and Open-Hearth steel and concerning the various alloys.

(3) The general statistics are also important, in showing a relation between broken rails and failure of head, web and base.

(4) Their tabulation discloses the difference between steel companies when the sections and chemical composition are practically the same.

The report by Mr. Wickhorst covers an investigation made at the South Works of the Illinois Steel Company, to throw light on the relationship of the size of ingots of Bessemer Rail steel to the segregation of the metalloids, locations of pipes and blow holes, and the properties of the rails. This investigation showed that under the conditions of the tests, the carbon, phosphorus and sulphur collected or segregated toward the interior and upper part of the ingot and that, in a general way, such segregation increased as the size of the ingot increased. The manganese also segregated some, but to a much smaller extent, while the silicon showed little or no tendency to segregate.

The elements which segregated as described also showed a lowering in the top part of the ingot, below the average composition of the steel, and this lowering extended downward along the sides of the ingot. The "negative" segregation increased in general as the size of the ingot increased and also extended down further along the sides of the ingot. There was also a region of negative segregation in the interior and lower part of the ingot, but the lowering of the elements was not as great in this region.

This investigation also indicated that the material was distributed in the rail bar about the same, relatively, as it was in the ingot from which the rail bar had been rolled.

(C) Tests of Rail Steel Ingots and Derivative Shapes Made at Watertown Arsenal, being a Review by M. H. Wickhorst of the Report Published by the Watertown Arsenal (Bulletin No. 139, September, 1911).

This report covers a digest and analysis of the government investigation at the Watertown Arsenal of rail steel ingots and derivative shapes as embodied in the Report of Tests of Metals, etc., made at the Watertown Arsenal for the year 1909.

The work indicated that the interior cavities of an ingot cooled directly after pouring are about the same or slightly less than in a similar ingot placed in the soaking pit and then cooled. This same result was also indicated as true of blooms made from such ingots.

It was shown that almost the full tensile strength and ductility of the metal of the lower part of the ingot were obtained rolling to about one-tenth of the original cross-section, but with the metal of the upper part of the ingot it was necessary to reduce the cross-section to one-twenty-fifth or less of the original amount.

A great many etchings were made and it was shown that the structure of the cross-section as developed by etching varies from the top to the bottom of the ingot and that each structure finds its counterpart in succeeding shapes and at about the same proportionate distance from the top end. It was also shown that the structure was considerably altered by changing the position in which the ingot was allowed to cool, as for instance allowing it to cool on its side after stripping.

(E) Influence of Rolling Temperature on the Properties of Bessemer Rails, by M. H. Wickhorst, November, 1911.

This report covers an investigation made at the works of the Carnegie Steel Company to determine the influence of the temperature of rolling on the properties of Bessemer rails. This work indicated that the ductility and deflection in the drop test were influenced little, if any, by the rolling temperature. The number of blows that it took to break the rails in the drop test were uninfluenced by the temperature of rolling. The yield point and tensile strength in the tension tests were influenced little, if any. The elongation in the tension test decreased some as the temperature increased. The influence of temperature showed most prominently in the tension test, in the reduction of area, which decreased as the temperature of rolling increased. The size of the grain, as shown by the microscope, increased as the temperature increased.

In this report it is also pointed out that the ductility in the drop test with the head of the rail in tension more nearly indicates the ductility of the interior metal as measured in the tension test, than does the ductility in the drop test with the base of the rail in tension, which is usual in inspection work.

Each report mentioned above gives a short summary of the matter contained in it, but the main principles that seem to have been brought out by the year's work are brought out in the brief reviews above.

The general plan of our research work during the year has been to direct attention to some one item which enters as a factor in the properties of the finished rail and attempt to obtain definite information concerning its influence by the experimental methods of obtaining as great a range as practicable in the one item under consideration, but leaving all other conditions as near alike as obtainable in the several experiments. It is thus hoped to establish in the course of time the metallurgical principles and laws that apply to the manufacture of steel rails.

(1) The first item of work for the Rail Committee according to the instructions for 1911, was to recommend changes in the specifications for steel rails.

Considerable work has been done during the past year in the preparation of specifications, and the specifications submitted herewith are recommended by your committee. Some paragraphs, such as Nos. 5, 6, 14 and 15, are not to be considered as final, it being thought that the committee did not have sufficient information in its possession to make these sections in the specifications mandatory.

One of the sections in question, No. 14, refers to the ductility test.

The requirements, in the specifications, for ductility are somewhat lower than some members of your committee think desirable, and it is hoped that sufficient information will be obtained during the coming year to enable the committee to make some revision in these respects.

Paragraph No. 15, referring to deflections as a method of classifying rails, is also tentative. It is the intention when sufficient data is at hand to prescribe maximum and minimum limits for deflections under the drop test.

(2) Present recommendations on standard rail sections.

The committee reports progress.

(3) Continue investigations of the breakage and failure of rails and present summary of conclusions drawn from reports received.

Bulletin No. 137, July, 1911, contains the rail failure statistics for the year ending October 31, 1910, and the conclusions in regard to the matter are presented in that report.

(4) Report on the results obtained from the use of Open-Hearth and Special Alloy Steel Rails, and the Chemical Composition of such rails.

Bulletin No. 137, referred to above, containing the report of the rail failure statistics, also gives all the information that the committee has in regard to Open-Hearth and Special Alloy Steel Rails.

In regard to the remaining part of the outline of work for the year 1911, the committee reports no progress.

The committee desires to call attention to the valuable services rendered by Mr. M. H. Wickhorst, engineer of tests, for the committee. Mr. Wickhorst has succeeded in winning the confidence of the manufacturers and has thereby succeeded in securing their co-operation in the work which is being done. Considerable light has been thrown upon the subject by these investigations of Mr. Wickhorst, and it is hoped that in the future considerable good will be accomplished as a result of the investigations.

Your committee desires to acknowledge the very generous manner in which the various rail manufacturers have offered us the material and facilities of their mills to carry on this research work. The condition of co-operation that we are working under is very gratifying and, it would seem, must work toward the best interests of the railroads, the steel mills and the general public.

The committee recommends the following lines for investigation during the coming year:

(1) Recommend changes in specifications for steel rails.

(2) Present recommendations on standard rail sections.

(3) Continue investigation of the breakage and failure of rails and present summary of conclusions drawn from reports received.

(4) Report on the results obtained from the use of Open-Hearth and Special Alloy Steel Rails, and the Chemical Composition of such rails.

(5) Present reports on the results of tests made on the various kinds of rail in conjunction with the manufacturers' committee on the revolving machine at South Chicago.

(6) Report on standard drilling for rails.

Special Investigations by Mr. Wickhorst.

(1) Test Open-Hearth Steel in ingots of various sizes.

(2) Influence of height of ingot with usual cross-section—

(a) Bessemer Steel.

(b) Open-Hearth Steel.

(3) Influence of temperature of rolling on high carbon Open-Hearth steel.

(4) Drop tests. Influence of temperature of test piece on ductility and deflection in drop test.

(5) Tests with reciprocating machine, especially to determine influence of interior segregation.

(6) Influence of Titanium—

(a) Bessemer Steel.

(b) Open-Hearth Steel.

(7) Influence of thickness of mold on segregation and cavities cast in sand and in molds of various thickness—

(a) Bessemer Steel.

(b) Open-Hearth Steel.

(8) Influence of methods of cooling on the cooling beds, especially with high carbon steels; also the effects of cold straightening.

(9) Influence of the temperature of the liquid steel when poured into molds.

(10) Experiments with methods of casting ingots for improvements as regards blow holes, pipes, etc.

(11) Drop tests, permanent set, ductility, etc.

(a) Influence of carbon.

(b) Influence of phosphorus.

(c) Influence of manganese.

(d) Influence of span of supports.

(e) Influence of moment of inertia.

SPECIFICATIONS FOR CARBON STEEL RAILS.

Inspection.

Access to Works.

1. Inspectors representing the purchaser shall have free entry to the works of the manufacturer at all times while the contract is being executed, and shall have all reasonable facilities afforded them by the manufacturer to satisfy them that the rails have been made in accordance with the terms of the specifications.

Place for Tests.

2. All tests and inspections shall be made at the place of manufacture, prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the mill.

Material.

Material.

3. The material shall be steel made by the Bessemer or Open-Hearth process provided by the contract.

Chemical Requirements.

Chemical Composition.

4. Th chemical composition of the steel from which the rails are rolled, determined as prescribed in Section 7, shall be within the following limits:

Elements	For Bessemer Process		For Open-Hearth Process	
	70 lbs. and over, but under 85 lbs.	85 - 100 lbs. inclusive	70 lbs. and over, but under 85 lbs.	85 - 100 lbs. inclusive
Carbon	0.40 to 0.50	0.45 to 0.55	0.53 to 0.68	0.63 to 0.78
Manganese	0.80 to 1.10	0.80 to 1.10	0.60 to 0.90	0.60 to 0.90
Silicon not to exceed	0.20	0.20	0.20	0.20
Phosphorus not to exceed	0.10	0.10	0.04	0.04

Specified Chemical Composition of Rails.

Modification of Carbon for Low Phosphorus.

5. When the material used at any mill is such that the average phosphorus content of the ingot metal used in the Bessemer process is running below 0.08 and in the Open-Hearth process is running below 0.03, and if it seems mutually desirable, the carbon may be increased at the rate of 0.035 for each 0.01 that the phosphorus content of the ingot metal used averages below 0.08 for Bessemer steel, or 0.03 for Open-Hearth steel.

Average Carbon.

6. It is desired that the percentage of carbon in an entire order of rails shall average as high as the mean percentage between the upper and lower limits specified.

Analyses.

7. In order to ascertain whether the chemical composition is in accordance with the requirements, analyses shall be furnished as follows:

(a) For Bessemer process the manufacturer shall furnish to the inspector, daily, carbon determinations for each heat before the rails are shipped, and two chemical analyses every twenty-four hours representing the average of the elements, carbon, manganese, silicon, phosphorus and sulphur contained in the steel, one for each day and night turn respectively. These analyses shall be made on drillings taken from the ladle test ingot not less than one-eighth inch beneath the surface.

(b) For Open-Hearth process, the makers shall furnish the inspectors with a chemical analysis of the elements, carbon, manganese, silicon, phosphorus and sulphur, for each heat.

(c) On request of the inspector, the manufacturer shall furnish drillings from the test ingot for check analyses.

Physical Requirements.

Physical Qualities.

8. Tests shall be made to determine.

(a) Ductility or toughness as opposed to brittleness.

(b) Soundness.

Method of Testing.

9. The physical qualities shall be determined by the drop test.

Drop Testing Machine.

10. The drop testing machine used shall be the standard of the American Railway Engineering Association.

(a) The tup shall weigh 2,000 lbs., and have a striking face with a radius of five inches.

(b) The anvil block shall weigh 20,000 lbs., and be supported on springs.

(c) The supports for the test pieces shall be spaced three feet between centers and shall be a part of, and firmly secured to the anvil. The bearing surfaces of the supports shall have a radius of five inches.

Pieces for Drop Test.

11. Drop tests shall be made on pieces of rail not less than four ft. and not more than six ft. long. These test pieces shall be cut

from the top end of the top rail of the ingot, and marked on the base or head with gage marks one inch apart for three inches each side of the center of the test piece, for measuring the ductility of the metal.

Temperature of Test Pieces.

12. The temperature of the test pieces shall be between 60 and 100 degrees Fahrenheit.

Height of Drop.

13. The test piece shall, at the option of the inspector, be placed head or base upwards on the supports, and be subjected to impact of the tup falling free from the following heights:

For 70-lb. rail .....16 ft.
For 80, 85 and 90-lb. rail.....17 ft.
For 100-lb. rail .....18 ft.

Elongation or Ductility.

14. Under these impacts the rail under one or more blows shall show at least 6 per cent. elongation for one inch, or 5 per cent. each for two consecutive inches of the six-inch scale, marked as described in Section 11.

Permanent Set.

15. It is desired that the permanent set after one blow under the drop test shall not exceed that in the following table, and a record shall be made of this information.

Rail			Permanent Set, measured by Middle Ordinate in Inches in a Length of 3 Feet	
Section	Weight per Yard	Moment of Inertia	Bessemer Process	O.-H. Process
A.R.A.-A	100	48.94	1.65	1.45
A.R.A.-B	100	41.30	2.05	1.80
A.R.A.-A	90	38.70	1.90	1.65
A.R.A.-B	90	32.80	2.20	2.00
A.R.A.-A	80	28.80	2.85	2.45
A.R.A.-B	80	25.00	3.15	2.85
A.R.A.-A	70	21.05	3.50	3.10
A.R.A.-B	70	18.60	3.85	3.50

Permanent Set in the Drop Test.

Test to Destruction.

16. The test pieces which do not break under the first or subsequent blows shall be nicked and broken, to determine whether the interior metal is sound.

Bessemer Process Drop Tests.

17. One piece shall be tested from each heat of Bessemer steel

(a) If the test piece does not break at the first blow and shows the required elongation (Section 14), all of the rails of the heat shall be accepted, provided that the test piece when nicked and broken does not show interior defect.

(b) If the piece breaks at the first blow, or does not show the required elongation (Section 14), or if the test piece shows the required elongation but when nicked and broken shows interior defect, all of the top rails from that heat shall be rejected.

(c) A second test shall then be made of a test piece selected by the inspector from the top end of any second rail of the same heat, preferably of the same ingot. If the test piece does not break at the first blow, and shows the required elongation (Section 14), all of the remainder of the rails of the heat shall be accepted, provided that the test piece when nicked and broken does not show interior defect.

(d) If the piece breaks at the first blow, or does not show the required elongation (Section 14), or if the piece shows the required elongation, but when nicked and broken shows interior defect, all of the second rails from that heat shall be rejected.

(e) A third test shall then be made of a test piece selected by the inspector from the top end of any third rail of the same heat, preferably of the same ingot. If the test piece does not break at the first blow and shows the required elongation (Section 14), all of the remainder of the rails of the heat shall be accepted, provided that the test piece when nicked and broken does not show interior defect.

(f) If the piece breaks at the first blow, or does not show the required elongation (Section 14), or if the piece shows the required elongation, but when nicked and broken shows interior defect, all of the remainder of the rails from that heat shall be rejected.

Open-Hearth Process Drop Tests.

18. Test pieces shall be selected from the second, middle and last full ingot of each open-hearth heat.

(a) If two of these test pieces do not break at the first blow and show the required elongation (Section 14), all of the rails of the heat shall be accepted, provided that these test pieces when nicked and broken do not show interior defect.

(b) If two of the test pieces break at the first blow, or do not show the required elongation, or if any of the pieces that have been tested under the drop when nicked and broken show interior defect, all of the top rails from that heat shall be rejected.

(c) Second tests shall then be made from three test pieces selected by the inspector from the top end of any second rails of the same heat, preferably of the same ingots. If two of these test pieces do not break at the first blow and show the required elongation (Section 14), all of the remainder of the rails of the heat shall be accepted, provided that the pieces that have been tested under the drop when nicked and broken do not show interior defect.

(d) If two of these test pieces break at the first blow or do not show the required elongation (Section 14), or if any of the pieces that have been tested under the drop when nicked and broken show interior defect, all of the second rails of the heat shall be rejected.

(e) Third tests shall then be made from three test pieces selected by the inspector from the top end of any third rails of the same heat, preferably of the same ingots. If two of these test pieces do not break at the first blow, and show the required elongation (Section 14), all of the remainder of the rails of the heat shall be accepted, provided that the pieces that have been tested under the drop when nicked and broken do not show interior defect.

(f) If two of these test pieces break at the first blow or do not show the required elongation (Section 14), or if any of the pieces, that have been tested under the drop when nicked and broken show interior defect, all of the remainder of the rails from that heat shall be rejected.

No. 1 Rails.

19. No. 1 classification rails shall be free from injurious defects and flaws of all kinds.

No. 2 Rails.

20. (a) Rails, which, by reason of surface imperfections, or for causes mentioned in Section 30 hereof, are not classed as No. 1 rails, will be accepted as No. 2 rails, but No. 2 rails which contain imperfections in such number or of such character as will, in the judgment of the inspector, render them unfit for recognized No. 2 uses, will not be accepted for shipment.

(b) No. 2 rails to the extent of 5 per cent of the whole order will be received. All rails accepted as No. 2 rails shall have the ends painted white and shall have two prick punch marks on the side of the web near the heat number near the end of the rail, so placed as not to be covered by the splice bars.

Details of Manufacture.

Quality of Manufacture.

21. The entire process of manufacture shall be in accordance with the best current state of the art.

Bled Ingots.

22. Bled ingots shall not be used.

Discard.

23. There shall be sheared from the end of the bloom, formed from the top of the ingot, sufficient metal to secure sound rails.

Lengths.

24. The standard length of rails shall be 33 ft., at a temperature of 60 degrees Fahrenheit. Ten per cent of the entire order will be accepted in shorter lengths varying by 1 ft. from 32 ft. to 25 ft. A variation of one-fourth inch from the specified lengths will be allowed. No. 1 rails less than 33 ft. long shall be painted green on both ends.

Shrinkage.

25. The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot saws, for a rail 33 feet in length and of 100 lbs. section, of six and three-fourths inches and one-eighth inch less for each ten lbs. decrease in section.

Cooling.

26. The bars shall not be held for the purpose of reducing their temperature, nor shall any artificial means of cooling them be used after they leave the finishing pass. Rails, while on the cooling beds, shall be protected from snow and water.

Section.

27. The section of rails shall conform as accurately as possible to the template furnished by the Railroad Company. A variation in height of one-sixty-fourth inch less or one-thirty-second inch greater than the specified height, and one-sixteenth inch in width of flange, will be permitted; but no variation shall be allowed in the dimensions affecting the fit of the splice bars.

Weight.

28. The weight of the rails specified in the order shall be maintained as nearly as possible, after complying with the preceding Section. A variation of one-half of 1 per cent from the calculated weight of section, as applied to an entire order, will be allowed.

Payment.

29. Rails will be accepted and paid for according to actual weights.

Straightening.

30. The hot straightening shall be carefully done, so that gagging under the cold presses will be reduced to a minimum. Any

rail coming to the straightening presses showing sharp kinks or greater camber than that indicated by a middle ordinate of 4 inches in 33 feet, for A. R. A. type of sections, or 5 inches for A. S. C. E. type of sections, will be at once classed as a No. 2 rail. The distance between the supports of rails in the straightening presses shall not be less than 42 inches. The supports shall have flat surfaces and be out of wind.

Drilling.

31. Circular holes for joint bolts shall be drilled to conform accurately in every respect to the drawing and dimensions furnished by the Railroad Company.

Finishing.

32. (a) All rails shall be smooth on the heads, straight in line and surface, and without any twists, waves or kinks. They shall be sawed square at the ends, a variation of not more than one-thirty-second inch being allowed; and burrs shall be carefully removed.

(b) Rails improperly drilled or straightened, or from which the burrs have not been removed, shall be rejected, but may be accepted after being properly finished.

Branding.

33. The name of the manufacturer, the weight and type of rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web. The number of the heat and a letter indicating the portion of the ingot from which the rail was made shall be plainly stamped on the web of each rail, where it will not be covered by the splice bars. The top rails shall be lettered "A," and the succeeding ones "B," "C," "D," etc., consecutively; but in case of a top discard of twenty or more per cent, the letter "A" will be omitted. Open-Hearth rails shall be branded or stamped "O. H." All markings of rails shall be done so effectively that the marks may be read as long as the rails are in service.

34. All classes of rails shall be kept separate from each other.

35. All rails shall be loaded in the presence of the inspector.

Discussion.

C. S. Churchill.—I move that specifications be taken up by paragraphs.

W. C. Cushing (President).—We have with us Mr. James E. Howard of the bureau of standards, and we will be very glad to hear from him at this time.

James E. Howard.—I think the work of your committee is very satisfactory, and they have formulated some very good specifications. I never feel like tieing myself down very closely to specifications. They are highly necessary, but I don't think they should be too rigid. The drop test gives us an indication as to how well the metal has been worked, but doubt if it gives us much more than this information. The drop test goes beyond the elastic limit, so that we cannot determine the elastic limit from this test. The fact that the metal has taken the shape of a rail, indicates that it has been well worked, so the drop test merely confirms that which we already know. I do not think that the drop test goes far enough. Tests which I have had the pleasure of conducting show that the fibre stresses vary with size and type of engines and wheel loads, and this question of stresses, a vital one, seems not to have been touched upon in tests and specifications. Analyses have shown that the chemical composition of rails may vary considerably in different parts of the section, and this feature should be investigated. I think we should have a medium amount of carbon, say .65 to .70. High carbon steel combined with high wheel pressures are very dangerous, I think.

The feature of ductility should be considered, as it is a known fact that material subjected to repeated high stresses will fail without showing any ductility at all. A low carbon steel, on the other hand, becomes brittle after being subjected to low stresses alternately in opposite directions.

High wheel pressures produce a cold rolling of high carbon steel rails, introducing interior compression strains. These stresses are counterbalanced by tensional strains below. To illustrate the results of these strains I will mention an experiment we made on a forged steel cylinder. This cylinder was subjected to a light hammering with a band hammer, and the metal was so disturbed that the bore was enlarged. The bore was restored to its original size by turning off a 1/8-inch layer of metal from the outside of the cylinder.

H. W. Sullivan.—Is it not a fact that elongation (paragraph 15) varies exactly as the mid ordinate, and could not the elongation be determined in this way?

C. S. Churchill.—We do not agree that there is a direct ratio, and our investigations have shown great variations if this method is used.

In answer to a question the chairman stated that they considered that the base of the rail should be up, when making the drop test.

L. C. Fritch.—It seems to me that we are at a point where we should accept no unsound material (Paragraph 17.) I think we should test a rail from every ingot. I think we should specify as follows: "In addition to the primary tests mentioned, tests should be made of each ingot as follows" to insure sound rails.

"A test piece shall be taken from an 'A' rail, and if when nicked and broken it shows defects, then all the 'A' rails shall be rejected. A test piece from a 'B' rail shall then be tested in the same manner, and if it shows a defect, all the 'B' rails shall be rejected. And this process shall be repeated till the rail tested is sound."

C. S. Churchill.—We have been working towards some such system as this, and may be able to recommend such tests next year. I do not think the rail manufacturers would accept such extensive tests at the present time.

L. C. Fritch.—I do not think that these tests would work any hardship on the manufacturers. On the other hand, I think it would result in a good many rails being accepted that would otherwise be rejected.

H. W. Sullivan.—We asked the rail companies to give us rails under these tests, and they agreed to do so at a cost of 50c extra per ton. I think the physical tests are merely a check on chemical analysis. I think that if a rail doesn't act satisfactory under the first blow of the drop hammer, that it should be rejected.

George W. Kittredge.—The New York Central lines have required subsequent blows and we have bought rails under these specifications for years.

L. C. Fritch.—I would suggest in paragraph 29, this change: "Rail accepted shall be paid for by actual weight."

C. S. Churchill.—The committee accepts that.

A motion was made that the specifications as amended be accepted and printed in the manual.

This motion was carried, and the report adopted.

ROADWAY.

J. E. Willoughby, Chairman; W. M. Dawley, Vice-Chairman; J. R. W. Ambrose, John C. Beye, D. J. Brumley, W. C. Curd, Paul Didier, R. C. Falconer, S. B. Fisher, T. H. Gatlin, C. S. Millard, W. D. Pence, A. C. Prime, Hiram J. Slifer, J. A. Spielmann, John G. Sullivan, F. L. Wheaton, W. P. Wiltsee, R. C. Young.

That each of the four subjects assigned to your Committee might have attention, the membership of the Committee was grouped into like number of sub-committees.

(1) Present Formulae of General Application for Determining Waterway Areas Under Varying Conditions With the Consideration Also of Hydraulic Features.

W. D. Pence, Chairman; John C. Beye, Hiram J. Slifer, R. C. Falconer, F. L. Wheaton, Sub-Committee.

Your Committee has been considering for several years the possibility of preparing, or of selecting from the various formulae in common use, one that can be recommended for general application. The investigation made since the Committee's report to the annual convention in March, 1909, does not warrant the Committee in varying from the opinion then expressed and accepted by the Association (see Proceedings, Vol. 10, Part 2), to-wit:

"(1) In determining the size of a given waterway, carerful consideration should be given to local conditions, including flood height and flow, size and behavior of other openings in the vicinity carrying the same stream, characteristics of the channel and of the watershed area, climatic conditions, extent and character of traffic on the given line of road and probable consequences of interruptions to same, and any other elements likely to affect the safety or economy of the culvert or opening.

(2) (a) The practice of using a formula to assist in fixing the proper size of the waterway in a given case is warranted to the extent that the formula and the values of the terms substituted therein are known to fit local conditions.

"(b) Waterway formulae are also used as a guide in fixing or verifying culvert areas where only general information as to the local conditions is at hand.

"(c) The use of such formulae should not displace careful observation and the exercise of intelligent judgment on the part of the engineer.

"(d) No single waterway formula can be recommended as fitting all conditions of practice."

To the above the Committee added the following conclusions in its report to the annual convention, March, 1911 (Proceedings, Vol. 12, Part 3), to-wit:

"(1) There is a general relationship between the best-known waterway and run-off formulae. This relationship may be expressed by two terms, a varying co-efficient and a varying exponent.

"(2) The extent of this relationship for large and small areas is indicated by the Dun waterway data.

The Committee's work since the twelfth annual convention has been directed toward the consideration rather of the hydraulic features of the culvert, and while some progress has been made, the Committee is not prepared now to make any definite recommendation.

(2) Report on Unit Pressures Allowable on Roadbeds of Different Materials, Conferring with the Committee on Ballast.

R. C. Young, Chairman; J. R. W. Ambrose, C. S. Millard, S. B. Fisher, A. C. Prime, Sub-Committee.

The Committee has been collecting information for two years for the purpose of formulating a conclusion as to what unit pressures are allowable on the roadbed, and the Committee has come to the conclusion that since the available data treats of the sustaining power of soils below the surface, rather than of that of soils peculiarly exposed as the roadbed is to moisture, to the action of frost, and to the loadings peculiar to train service, it will be necessary to make experiments to determine the magnitude and distribution of the loads transmitted to the roadbed through ballast of various kinds and also to determine by test the bearing power of various materials under varying conditions ordinarily attained in the construction of the roadway. The Committee submits as information the following memorandum prepared by Mr. W. M. Dawley, its Vice-Chairman, after adjournment of the November, 1911, meeting:

"The safe bearing power of soils depends upon their character or composition, depth of strata, amount of water they contain or are liable to receive and the degree to which they are confined.

"Practically all of the published data in relation to the bearing power of soils is in connection with foundation work for bridges and buildings and the bearing values given are for loads applied at varying depths below the surface of the ground, hence on soils more or less well confined, and serve merely as a rough guide to the bearing power of soils other than rock when the load is applied at the surface and the soil is unconfined.

"Elmer L. Corthell has tabulated various existing pressure of stable structures which have shown no settlement. Data were obtained from 178 separate works, in response to letter sent to prominent engineers throughout the world, requesting their experiences. The average value given, Mr. Corthell says, is low, and a safe one lies between the average and maximum. (See 'Allowable Pressures on Deep Foundations,' Corthell, 1906.)

"G. F. Gebhardt gives values which are an average of maximum loads allowed in most cities under the building laws.

"Richard Delafield, Brevet Major-General, Corps of Engineers, United States Army, member of Light House Board in 'Memoir on Foundations in Compressible Soils,' Washington, D. C., 1881, says, on page 13:

" 'The compressibility of oolitic clays can only be overcome by piling, deep sinking, heavy ramming or heavy weighting. The point of bearing must be carried below the possibility of upward reaction. The depth of a foundation in compressible ground ought not to be less than one-fourth the intended height of the building above ground; that is, for a shaft of 200 ft., the foundation should be made secure to a depth of 50 ft. by piling or by well-sinking and concrete. (Engineer and Architectural Journal, for 1837.) Masses of concrete, brick or stone, placed on a compressible substratum, however cramped and bound, may prove unsafe. Solidity from a considerable depth alone can be relied upon. Mere enlargement of a base may not in itself be sufficient.'

"In experiments made by Hugh Leonard (M. A.) at Akra for the purpose of testing the ordinary undisturbed alluvial soil of Calcutta. 'The results showed that for Calcutta the weight on the foundation should not be more than one ton to the superficial foot.' Journal of Royal Institute of British Architects, 1900, pp. 390-394.

"In Cunningham's Dock Engineering, page 183, speaking of foundations for masonry dock walls, it is stated that 'The maximum intensity of pressure, at any point, should not exceed a certain limit, dependent upon the nature of the ground. The safe intensity of pressure on natural foundations has been determined as follows:

On hard rock	9	to 10	tons per sq. ft.
On soft rock and hard clay	2	to 3	tons per sq. ft.
On sand and gravel	1½	to 2	tons per sq. ft.
On compact earth	1	to 1½	tons per sq. ft.
On soft, uncertain ground		½	ton per sq. ft.

" 'In the case of natural foundations, care must be taken that there is no possibility of lateral escape,' and again at page 247, speaking of Lock Foundations:

" 'As a general rule, hard rock and stiff clay, in which there are no springs, do not call per se for any artificial covering, except such as may be judged necessary to protect their surface from the softening and scouring action of water. On the other hand, alluvial deposits, sand, gravel and other incohesive strata, need the confinement afforded by a superimposed mass in addition to the lateral support of sheet-piles.

" 'Earth of a porous nature, moreover, is not only unsuitable for a natural floor, but is equally undesirable as a foundation for an artificial floor, owing to its efficacy as a medium for the transmission of water pressure, on which account any covering laid upon it should be both strong and impervious.' "

Mr. Alfred C. Prime (Pennsylvania Railroad), a member of the Committee, reports as follows:

Rock Subgrade.

"A good quality of rock will stand up under the heaviest axle loads and under Class 'A' traffic it is sustaining axle loads on one pair of drivers of 61,500 lbs. without any signs of failure. Considering this load as distributed over two ties, gives a unit pressure of 850 lbs. per sq. ft. As stated previously the limit of bearing is unknown, but a good quality of rock will probably sustain, with proper ballast, the highest axle loads that can be placed upon it.

Clay Subgrade.

"I never had any satisfaction in maintaining tracks where roadbed subgrade was composed of clay. It has always resulted in a high maintenance cost. The track will get out of line and surface will require from one-third to one-half as much work again as where loam or sand is used. I personally believe that clay should never be used in fills on account of its high maintenance cost.

"A good grade of yellow clay will under Class 'B' traffic and axle loads of 61,500 lbs. with 6 in. of cinder ballast just sustain a pressure of about 900 lbs. per sq. ft. Speed of trains average 60 miles per hour.

Sandy Loam.

"This has always given me satisfaction where I have used it and had to maintain track. Under Class 'A' and 'B' traffic. speed 60-70 miles per hour with a proper depth of ballast it will maintain the heaviest axle loads that can be placed upon it. I know it is maintaining pressure of 900 lbs. per sq. ft. and how much more it is capable of sustaining is unknown.

Ocean Sand.

"For Class 'C' traffic this is a satisfactory subgrade for loads up to 700 lbs. per sq. ft., which is about the limit of economical maintenance.

"A sand subgrade can be made to sustain Class 'B' traffic by raising track about 18 in. on engine cinders.

"All figures given above are for a single track roadway 20 ft. wide with slopes of 1½ to 1, and good drainage, with 6 in. of cinder ballast below base of tie. Tie spacing 22 in.

"The only cheap and inexpensive method for determining unit pressures on subgrades known to me, is to spread some pliable substance such as fairly thin sheet lead on top of your subgrade for a length of say 5 ft. As long as this remains straight and undeformed your allowable unit pressure on subgrade is not being exceeded, but the moment it becomes cupped and dished under the ties, the unit pressure for this class of roadbed subgrade is too high.

"In connection with this work the report of the M. W. & S. Committee on Roadbed of the Altoona Railroad Club in May, 1909, on 'Drainage of a Four-Track Railroad,' contains some interesting matter, also a paper by Mr. M. L. Byers in Bulletin of the International Railway Congress for September, 1909."

Mr. O. E. Selby, Bridge Engineer, Cleveland, Cincinnati, Chicago & St. Louis (see Proceedings, Vol. 8, pp. 54-59), using the formula derived by Mr. Thos. H. Johnson (see Proceedings, Vol. 7. pp. 104-105), calculates the average pressure on subgrade to be 2.4 tons per sq. ft., and the maximum to be 3.6 tons for 50,000-lb. axle loads spaced 5 ft. centers, 80-lb. rail, 7 in. x 8 in. x 8½ ft. ties spaced 20-in. centers on 12 in. of gravel ballast.

From what has preceded it will be observed that the safe bearing power of confined soft wet clay, clear dry sand confined in natural beds, quicksand, marshy and alluvial soils, silt, etc., all confined, is less than or very slightly in excess of the pressure calculated by Mr. Selby. If unconfined, their bearing powers will all be somewhat reduced.

Semi-fluid soils such as quicksand, alluvium, etc., should be removed where practicable or the foundation carried to a lower stratum, so the bearing power of such need not be considered here.

The bearing power of clay, loam, sand, etc., depends to a great extent on the amount of moisture present.

Professor Schubler of Tübingen found that 100 lbs. of dry soil would retain the following amount of water that would not flow off:

Pure Clay	70 lbs.
Clay Loam	50 lbs.
Loamy Soil	40 lbs.
Sand	25 lbs.

Drainage Farm Journal, August, 1884.

The water which destroys the bearing power of such soils may come from below by capillary attraction. The vertical capillary movement per each horizontal square foot per 24 hours being as follows:

In fine sand through 1 ft. vertical	2.37 lbs.
In fine sand through 2 ft. vertical	2.07 lbs.
In fine sand through 3 ft. vertical	1.23 lbs.
In fine sand through 4 ft. vertical	.91 lbs.
In medium clay loam through 1 ft. vertical	2.05 lbs.
In medium clay loam through 2 ft. vertical	1.62 lbs.

In medium clay loam through 3 ft. vertical.... 1.00 lbs.
In medium clay loam through 4 ft. vertical.... .90 lbs.

If, as Professor Baker says, dry clay will sustain a load of from 6 to 8 tons per sq. ft. and soft wet clay will support but from 1 to 2 tons per sq. ft., it seems that the bearing power of clays and soils similarly affected by the presence of moisture should in each case be experimentally determined for varying percentages of moisture and such drainage arrangements made, and at such depths, as will always secure a percentage of moisture low enough to bring the bearing power up to the load it is required to carry.

(3) On Tunnel Construction and Ventilation.

Paul Didier, Chairman; W. M. Dawley, J. A. Spielmann, D. J. Brumley, W. P. Wiltsee, Sub-Committee.

Your Committee made recommendation to the annual convention of 1910 as to the cross-section to which tunnels should be constructed to conform to good practice. The recommendation was adopted (Manual 1911, page 43), and the Committee has since that convention confined its attention principally to the question of ventilation. No definite conclusion has been reached, but the opinion of the Committee leans to a belief that artificial ventilation is usually unnecessary in American steam railway tunnels of less length than 2,000 to 2,500 ft., and that probably the most efficient form of artificial ventilation for American steam railway tunnels is to force air into one end of the tunnel by fans powerful enough to drive the smoke out ahead of the train. This method was adopted for the Elkhorn tunnel on Norfolk & Western Ry., and is admirably described by Mr. Chas. S. Churchill in the Transactions of American Society of Civil Engineers, Vol. 54, part C. Plants similar to that constructed for the Elkhorn tunnel have been installed as shown by the record given as Appendix A. As typical single track tunnels carrying a moderate traffic, there is included in Appendix A a record as to the clearing of smoke in three single track tunnels on the Louisville & Nashville R. R. The Committee has advice that the Baltimore & Ohio Railroad Company is now experimenting on single and double track tunnel ventilation, but the various methods used in the different tunnels are at such great variance that no conclusion has as yet been reached.

(4) Report on the Question of Agricultural Drainage As It Affects Railways.

W. C. Curd, Chairman; T. H. Gatlin, John G. Sullivan, Sub-Committee.

The Committee during the past two years collected information as to the drainage laws of the various states, but has never been able to fix upon a form into which the information can be put so as to make it of value to the Association. The Committee is of the opinion that further work along the line of collecting information as to (a) Laws and Assessments is futile because the laws are changing constantly, and because the Committee's information is necessarily general and not subject to application to specific cases without legal advice; and further, questions affecting the laws and assessments are, in all railway organizations, handled by the railway's attorneys. The Committee recommends that it be discharged from further consideration of the subject as to Laws and Assessments.

Recommendations for 1912.

Your Committee recommends that Subjects 1, 2 and 3 be reassigned and that further consideration of subject 4 be confined to the benefits to the roadway to be derived by the construction of agricultural drainage ditches and levees.

Your Committee believes that certain additions can be made to the specifications as now printed in the Manual, for example, the sodding of slopes of cuts and fills.

Your Committee directs attention to a resolution passed at its meeting on November 28:

"Resolved, That the Board of Direction be requested to set aside an appropriation and to appoint a special committee consisting of members of the Roadway, Ballast and Track Committees, to make experiments to determine the magnitude and distribution of the load transmitted to the roadbed through ballast of various kinds and also to determine by test the bearing power of various materials under varying conditions ordinarily found in the construction of the roadway."

APPENDIX A.

Record of Tunnel Ventilation.

Letter of R. C. Morrison, Superintendent, Louisville & Nashville Railroad.

There has never been any trouble to trainmen from smoke in either Dossett or Solway tunnels, excepting in one instance; about three months ago an engineer on the second engine of a heavily loaded double-headed freight train claims to have been overcome by the gases while passing through Solway tunnel. We did not consider this claim very seriously. It was evidently a strike on the part of the engineer against double-heading.

In clear weather after No. 32 passes through these tunnels if no firing is done immediately before entering the tunnels or during the passage through the tunnels, it leaves the tunnel practically clear, whereas after a southbound freight train it takes from ten to fifteen minutes for the tunnels to clear sufficiently to see through them.

Damp weather affects the clearing of these tunnels very much. In fact, during very damp weather, doing an ordinary business Dossett tunnel never gets entirely clear. This does not apply so much in the case of Solway tunnel, as this tunnel seems to clear itself better of smoke than any tunnel I have ever known, considering the length.

We keep our trains ten minutes apart passing through both of these tunnels, both tunnels being protected by electric blocks. I am inclined to believe that the smoke in both of these tunnels comes out from the far end in the direction the train is moving, that is, when a train passes through the tunnel, it starts up a current of air that seems to continue after the train has passed and has a tendency to draw the smoke through the tunnel after the train.

During our heaviest business we have never been bothered with delay to traffic on account of smoke in either of these tunnels.

We have no established rules or instructions governing the method of firing while passing through tunnels. It is customary on heavily loaded freight trains, southbound, to put in a heavy fire going into either of these tunnels. It is very seldom necessary while passing through Dossett tunnel, but, on heavily loaded freight trains, they do have to put in a fire once and sometimes twice while in Solway tunnel.

For the first two weeks in October, average number of trains passing through these tunnels per 24 hours was 23. Our business, however, is a little light. I think I would be safe in saying that we could successfully operate fifty trains per day through these tunnels without the air becoming so foul as to delay traffic.

Length of Dossett tunnel 3,520 ft., single track. Grade 0.50 per cent, rising to south. Train 32 is northbound limited train.

Length of Solway tunnel 2,170 ft., single track. Grade 0.50 per cent, rising to south. The construction shafts in both tunnels were closed.

Letter of E. E. Snyder, Superintendent, Louisville & Nashville Railroad.

Muldraugh tunnel is on an ascending grade to the south of 70.3 ft. per mile. We regard the tunnel as a quick clearing one from smoke and gases. The hardest feature is on a southbound double-heading train when the crew of the second engine gets a good dose. All southbound full tonnage trains and our through passenger trains are double-headed, helping engine in front.

There is a little smoke and gas after a northbound freight train but not a great deal as the trains roll and there is but little exhaust. Northbound passenger trains do not work steam through tunnel. The helping engine always goes through the tunnel and is cut off at Tunnel Hill. We have about 40 train movements, divided one-half north and one-half south, per day, not including the return movement of the helping engine.

Letter of J. F. Burns, Roadmaster, Louisville & Nashville Railroad.

In regard to smoke in Muldraugh's tunnel, M. S. First Division. I attach a statement showing the action of the smoke after passage of southbound trains on the 7th inst. (October 7, 1911), from which it appears that trains are from one minute to two minutes in going through the tunnel and the tunnel is clear of smoke in from seven to twelve minutes. It so happened that the smoke was longest in clearing after passenger train 5 with a K1 engine, and the shortest time was with a double-heading freight train. I consider this tunnel as very quick clearing. As trains are never closer together than fifteen minutes in the tunnel, one train never has disadvantage from the smoke of a preceding train.

Action of Smoke in Muldraugh's Tunnel.

Main Stem First Division After Passage of Southbound Trains on 7th of October, 1911.

No. of Train.	Engine	Time Train Going Through Tunnel	Time After Engine Got Through Tunnel Until Clear of Smoke
73	1112 and 848	2 minutes	7 minutes
2nd 73	1107 and 848	2 minutes	8 minutes
31	881	1½ minutes	9 minutes
5 Passenger	153	1 minute	12 minutes
2nd 5	124 and 849	1 minute	11 minutes
17	731 and 849	1½ minutes	9 minutes
75	1176 and 849	2 minutes	10 minutes
2nd 75	709 and 848	1½ minutes	8 minutes

The report on "Roadway" was accepted as information without discussion.

WATER SERVICE.

Robert Ferriday, chairman; J. L. Campbell, vice-chairman; James Burke, H. M. Church, C. C. Cook, G. M. Davidson, A. F. Dorley, G. H. Herrold, E. G. Lane, G. C. Millett, A. Mordecai, W. A. Parker, C. L. Ransom, Chas. E. Thomas.

The Board of Direction assigned the following subjects:

(1) Report on the design and relative economy of track pans from an operating standpoint.

(2) Present typical plans and specifications for tank supports.

(3) Report on the use of reinforced concrete for water tanks and supports.

It was decided, since the subject of "Water Tanks," including

supports, had been under consideration so long, to request the Board to drop subject No. 2 and substitute "Deep Well Pumps," approval of which was given later.

The subjects in the hands of your committee stand as follows:

Revision of the Manual.

No changes to recommend until the Association decides on the future policy now under consideration.

(1) The Design and Relative Economy of Track Pans from an Operating Standpoint.

Report progress. No further report is made for the reason that such additional data as can be secured is from elaborate tests made by the Pennsylvania Railroad at Atglen, Pa., which are not yet available. Your Committee also hopes to secure report prepared for a Special Committee of the New York Central Lines by G. W. Vaughan, Engineer Maintenance of Way of that railway.

(2) Deep Well Pumps.

Report progress. This subject has not been developed sufficiently to report otherwise.

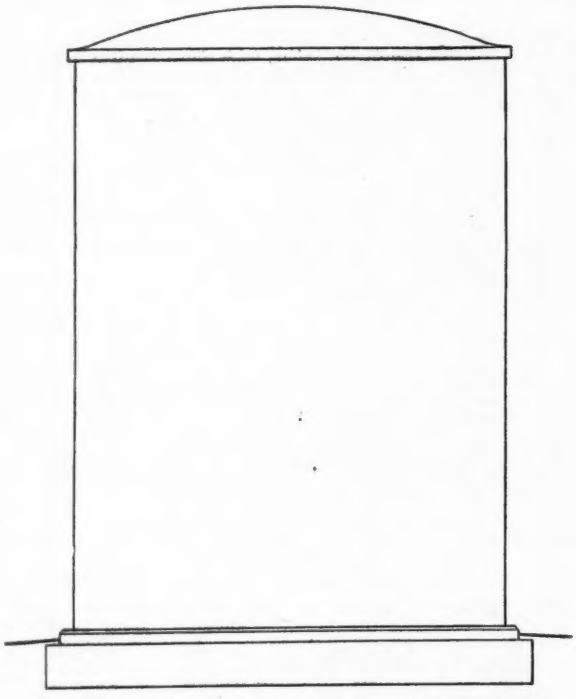
(3) Use of Reinforced Concrete for Water Tanks and Supports.

Complete report is hereinafter submitted with the request that it be received as information.

Progress was reported on "Water Treatment," and a paper was given in appendix "A" on "Locomotive Boiler Corrosion, following a Partial Installation of Softeners."

The Use of Reinforced Concrete for Railway Water Tanks and Supports.

As part of its work for the year 1910, the Water Service Committee was directed by the Association to prepare plans and specifications for a reinforced concrete water tank. The result of the Committee's work is published as information in the 1911 Proceedings.



Suggested Design for Reinforced Concrete Stand Pipe.

For the year 1911, the Committee is directed to report on the use of reinforced concrete for water tanks and supports.

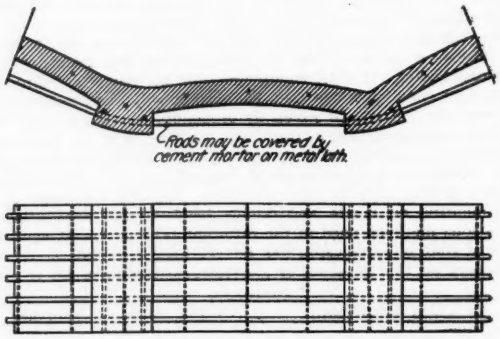
Many reinforced concrete tanks have been built in America and Europe ranging in capacity from 10,000 gals. to more than 1,000,000 gals. each. Published descriptions of a large number of these can be found by reference to the Engineering Index. A list of about 50 of them is published on page 124 of the Engineering News of July 27, 1911.

In connection with the construction of a new concentrator, the Mactezuma Copper Company, Nacozari, Sonora, Mexico, built 128 reinforced concrete tanks of 10,000 gals. capacity each for water and concentrates. They are water-tight except a little sweating around a few of the pipe connections in the tank bottom. These tanks are 12 ft. in diameter and 12 ft. high. The form was erected complete and each tank was poured in one operation, thereby eliminating joints in the shell, which is 6 in. thick. The bottom is 12 in. thick. A very rich concrete was used. All of the stone would pass through a screen having ¼-in. mesh. The steel in the shell is stressed 11,400 lbs. per sq. in., not considering the tensile strength of the concrete. At the bottom of the tank the concrete in the shell is stressed only 63 lbs. per sq. in. without assistance from the steel. The concrete in these tanks can carry that stress without breaking. Consequently, the stress is doubtless divided between the steel and the concrete and the unit stress must be very low. The vertical reinforcement of the shell consists of ¼-in. rods spaced 12 in. c. to c.

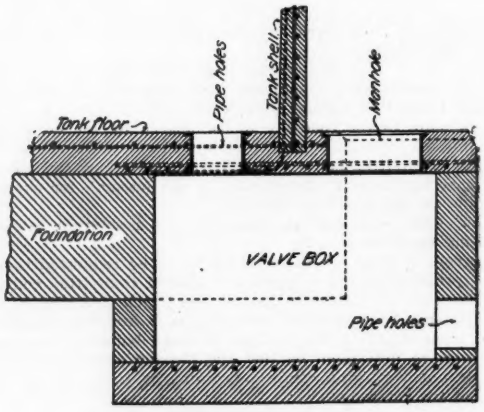
Reinforced concrete tanks have been built either as standpipes or as elevated tanks on concrete towers. The advantages are: (1) Low maintenance cost. (2) Great durability.

This may be true only of well-designed, well-built and water-tight tanks. The disadvantages are: (1) Innovation in railway service. (2) Imperfections in materials and workmanship. (3) Greater first cost. (4) Porosity of the concrete. (5) Shrinkage of the concrete. (6) Stretch of the concrete. (7) Difficulty of waterproofing. (8) Effect of frost on saturated concrete. (9) Ugliness. (10) Immovability.

No. 1 will be removed in time if the concrete tank develops sufficient merit.



SUGGESTED PLAN AND ELEVATION FOR A CONCRETE TANK SHELL DESIGNED TO BE IN COMPRESSION



SUGGESTED SECTION THROUGH VALVE BOX

Sections of Proposed Reinforced Concrete Water Tank.

No. 2 is more incidental than fundamental, but the making of a strictly uniform high-grade monolithic concrete construction without local imperfections is difficult and requires highly efficient workmanship.

No. 3 may be justified by the advantages named. It can be shown in some cases that a reinforced concrete tank costs less than a steel tank of like capacity, but in such cases the design is probably sparing in the use of steel and concrete. A thin shell and a high stress in the steel are liable to result in a leaky tank. Generally, when the stress in the steel is low enough and the

tank shell thick enough to insure against leakage, the cost of a reinforced concrete tank will be greater than that of a steel tank.

No. 4 is the root of much of the trouble with the concrete tank. It is not an insurmountable difficulty. Careful selection and grading of sand and stone, liberal use of cement, complete and uniform mixing and proper placing will make a concrete impervious under the pressures required for railway water service. Serious leaks will be due to local imperfections rather than to porosity if the tank has been well-designed and constructed of a proper grade of concrete.

No. 5 is a more fundamental difficulty. Shrinkage of concrete in setting is inevitable and it is increased by the large proportion of cement required in water tank construction. This frequently produces cracks, especially along the joints between successive courses of concrete. Careful and proper making of the joints and judicious steel reinforcement are necessary to prevent serious shrinkage cracks. The steel dam mentioned in the accompanying general specifications is a desirable thing in the joints when the concrete in the first half of the joint has hardened before the concrete in the second half is placed.

No. 6 is a serious difficulty in the shell of the tank due to elasticity of the steel reinforcement and its stretch under the water load. Any concrete, however dense and impervious in its unstrained condition, can be stretched beyond its breaking strength and fine cracks through which water will flow under pressure may be opened therein by stressing the steel within the elastic limit of the latter. If the tank could be maintained constantly full of water the moderate leakage due to such stretch would generally stop through deposits of suspended matter from the filtering water. In some cases this would be assisted by chemical precipitation. But under general service conditions there is a wide fluctuation of pressure and the elastic recovery of the steel as the pressure drops appears to break down the plugging action of the leakage above indicated in those cases where the steel is stretched materially beyond the breaking point of the concrete.

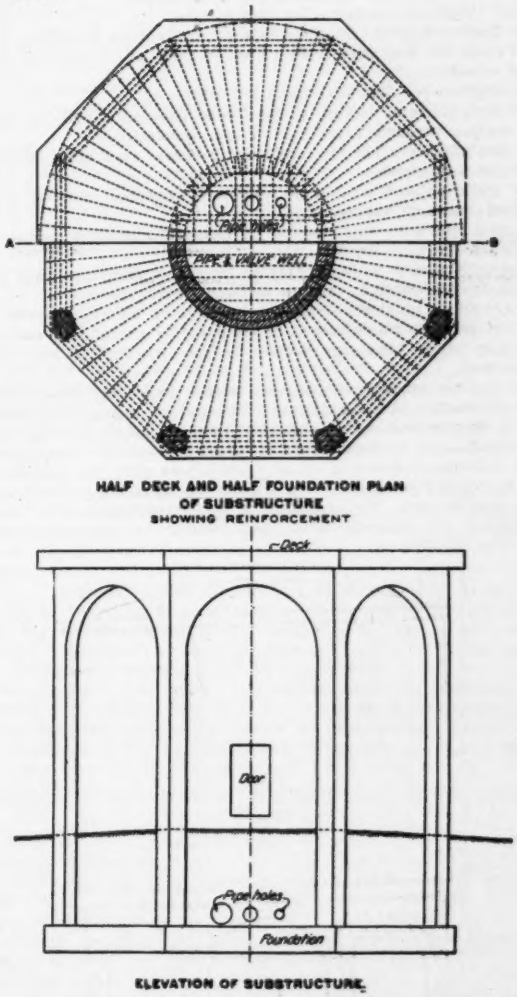
Herein appears to lie a formidable handicap of the concrete tank as competitor of the steel tank on the basis of cost. The effectual remedy appears to be the combination of that low stress in the steel with that increased thickness of the shell which will limit the stretch of the concrete so that cracks permitting the filtration of water will not be opened. That increases the cost of concrete and steel, making the latter approach the cost of steel in a steel tank.

Your Committee is of the opinion that the ultimate stress of the steel without assistance from the tensile strength of the concrete should not exceed 10,000 lbs. per sq. in., and that the minimum thickness in inches of the concrete at any point should be such that when the total tensile stress due to water load at that point is diminished by 3,000 times the sectional area in sq. in. of the steel at that point, the remaining water load will stress the concrete at that point 300 lbs. per sq. in., provided that in no case shall the thickness of concrete be less than 4 in. Your Committee does not say that concrete will not break under a tensile stress of 300 lbs. per sq. in., although experiments indicate that concrete of the high grade required for tank construction may have an ultimate tensile strength of 400 to 500 lbs. per sq. in.

This specification as to thickness of concrete is an arbitrary one intended to secure a minimum and reasonable thickness somewhat in excess of the thickness of concrete in tanks already constructed in which the stress in the steel has been 12,000 lbs. or more per sq. in., resulting in some leakage. The primary object is to secure a minimum thickness of wall in which tension cracks, if any, will be localized and minute and through which it would be difficult for water to pass. The size and the arrangement of the reinforcing rods have an important bearing on the minimum permissible thickness of concrete. The shrinkage of the concrete around large rods in a thin wall is liable to crack the concrete.

The trouble from stretch of the concrete raises the question as to the practicability of designing a tank shell to be in compression. This could be accomplished by building the shell as a series of short, flat, abutting arches convex to the center of the tank with the reinforcing steel supported by exterior pilasters forming the abutments of the arches, as indicated in the suggested plan and elevation of a section of concrete tank shell designed to be in compression appearing on the accompanying drawing, showing a general plan and general section for a suggested concrete standpipe. The radius of the arches may readily be proportioned to make the total compression in the concrete equal to the total tension in the steel. The reinforcing rods between the pilasters may be covered by metal lath and cement plaster. The density and imperviousness of the concrete in the arches would be increased by the water load. The polygonal form of the tank with its recessed panels would break the monotony of a plain cylinder and give the tank an improved appearance. Doubtless difficulties would arise in the execution of such a design, but without going into details, the suggestion is offered for what it is worth.

No. 7 arises from 4, 5, and 6. The problem is to find some foreign substance which, when incorporated with the concrete, will close the percentage of voids found even in the best grade of concrete, or, when applied to the surface, will be impervious and will not crack or peel off. In either case the trouble is aggravated and the waterproofing largely nullified by the shrinking and stretching of the concrete unless the latter is properly reinforced against shrinkage and stretch. Tanks in service prove that it is practicable to make concrete impervious under ordinary tank pressures by proper selection, grading and mixing of materials. Soap and alum incorporated with the concrete in the making and applied as washes to the surface are probably the best proved and most efficient materials for effective waterproofing of concrete.



Suggested Plan for Reinforced Concrete Water Tank.

No. 8 is a danger which will be eliminated by successful solution of waterproofing. Since the latter will require as its base a very dense concrete, the quantity of water passing through the latter will be so small that the action of frost can have little or no effect on such close grained and practically dry concrete. It is a fact, however, that in our northern latitudes much disintegration of porous concrete on the water line of lakes and streams due to the annual effect of the frost season is apparent.

Ugliness is a sin chargeable to some railway structures other than water tanks. Perhaps a little additional homeliness is not unpardonable if saved by the grace of utility. Monolithic concrete, especially a form-marked, point-marked, leaky efflorescent tank shell possesses a lack of beauty which is not hidden by frills. The attainment of a water-tight tank requires a high grade of material and work which will go far toward making concrete tanks presentable in appearance.

An irremovable objection to the concrete tank is its immovability. A wooden tank and even a steel tank can be and such

tanks are moved from place to place to meet changing requirements of railway water supply. Discovery of new and better water supplies sometimes makes changes in locations of tanks desirable. A concrete tank should be located only at those points where there is no probability of change.

Considering the obvious merits of the concrete tank, this Committee sees no reason why railways engaged in permanent reconstructions for fixed water supplies should not favorably consider a beginning in reinforced concrete tank construction. Watertightness is the important problem. The stability of this form of construction is well established.

Many existing concrete tanks are practically water-tight. Generally, leakage is immaterial in amount and objectionable principally as a matter of appearance and a possible danger account of frost. It is more often the result of local imperfections, bad joints, and a thin shell and a high stress in the steel than porosity and permeability in a proper grade of concrete.

Your Committee submits as information:

(1) General Specifications for Reinforced Concrete Standpipe Water Tanks for Railways. No plans of tank are submitted with these specifications.

(2) Suggestive sketches consisting of:

An elevation and section of reinforced concrete standpipe tank.

A section through valve box in the foundation.

A plan and elevation for reinforced concrete tank shell designed to be in compression.

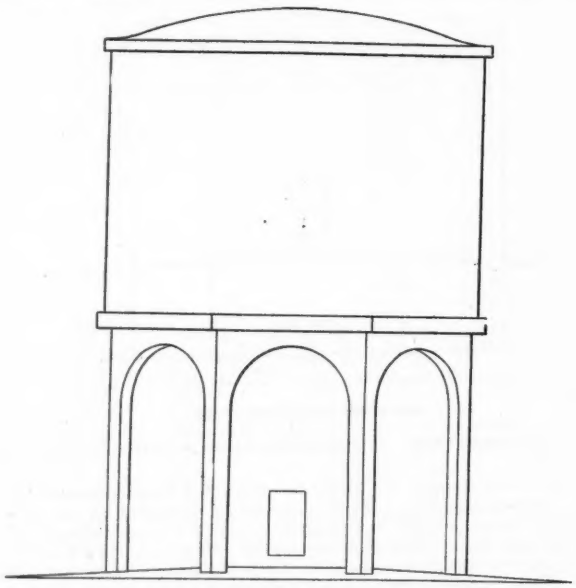
An elevation and section of reinforced concrete tank on a reinforced concrete substructure.

A plan, elevation and section of reinforced concrete substructure.

The tank should be located away from the main line track and should deliver water to engines through water columns.

If a roof is required, it should be built as shown. Where ice will not form to an injurious or troublesome extent and sunlight will not cause vegetable growth in the water, the roof may be omitted.

For a given amount of available storage and considering piping, frost-proofing, and collection and disposal of sludge, the standpipe is simpler and more economical than a tank on a tower, notwithstanding it is practicable to erect a concrete tower 20 ft. high, including foundation at an expense less than the cost of the foundation and lower 20 ft. of a concrete standpipe. This refers to railway service. For quantities of water required only at higher elevations, the concrete tower may readily be more economical than the standpipe.



Elevation of Suggested Reinforced Concrete Water Tank.

The construction of the concrete tank on the concrete substructure would not differ materially from that of the concrete standpipe, and the general specifications for the latter may be applied generally to the former.

The substructure may also be used for supporting tanks of wood or steel. Its general design consists of an octagonal foundation slab and an octagonal deck slab, the latter being carried on the reinforced columns and the central pipe and valve well resting on the foundation. The foundation slab distributes the load under its entire area, keeps the unit load low and is favorable to uniform settlement, if any. On a rock foundation this slab may be omitted. The central well serves for enclosing and frost-proofing the piping and valves, helps to support the deck and makes the entire sub and superstructure stable against wind pressure without assistance from the surrounding columns. The plan contemplates a substructure not more than 20 ft. high above the ground, in which case the columns require no lateral bracing. In the construction of the substructure the ordinary approved building loads, stresses, materials and workmanship for reinforced concrete are acceptable and sufficient. The question of waterproofing does not enter unless it is desired to make the deck slab the bottom of the tank when the latter is made of concrete.

These general plans are submitted, not as those which should be adopted, but as suggestions for a number of good designs which could be made.

GENERAL SPECIFICATIONS FOR A REINFORCED CONCRETE STANDPIPE WATER-TANK FOR RAILWAYS.

No Plans Submitted.

Definitions.

1. The words "company," "engineer," "as shown," "drawings," and "this Association," appearing in these specifications are defined as follows:

"Company" means the railway company building a tank under these specifications.

"Engineer" means the engineer of the company.

"As shown" means as shown on the drawings.

"Drawings" means the drawings of the tank herein specified and forming a part of these specifications, including such working drawings as the engineer shall prepare or approve.

"This Association" means the American Railway Engineering Association.

Kind.

2. This tank shall be of reinforced concrete as shown.

Excavations.

3. In earth, excavation for the foundation should be as deep as the lowest frost line. In rock, only the excavation for the valve box should be carried below the action of frost. In earth, the bottom of the excavations should be thoroughly tamped. If the earth will not sustain the total load, including wind pressure, without material or unequal settlement, the foundation should be supported on piles of the number, size and arrangement as determined by the engineer. Such piles should conform to the specifications of this Association for piling as selected by the engineer.

Foundation.

4. The foundation should be monolithic concrete of the form and dimensions as shown. If the depth of frost is excessive the foundation may be carried on broken rock uniformly compacted in the bottom of the excavation. The top of the foundation should be above the surface of the ground.

Floor.

5. The tank floor shall be constructed on the foundation as shown.

Valve Box.

6. The valve box shall be constructed as shown. When low temperatures require to prevent freezing within the valve box, an air space should be constructed in the middle of the valve box walls as shown.

Shell.

7. The concrete shell shall be constructed and the connection between it and the floor shall be as shown. Its thickness should have a proper relation to the sizes and positions of the reinforcing rods so that the concrete will not crack in shrinking around the rods.

Piping and Valves.

8. This tank should be equipped with standard iron pipes and standard gate valves located in the valve box as shown. The pipes should pass from the valve box in iron sleeves with lead joints into the tank as shown. There should be a tank supply pipe, a washout pipe, a water column supply pipe, and if required, an overflow pipe. For a gravity water supply, an altitude controlling valve in the valve box or a float valve in the tank should be placed in or on the tank supply pipe as shown. The tank supply pipe and the water column supply pipe should extend above the floor of the tank, but the water column supply pipe should not rise higher than the top of the water columns served. The washout pipe should terminate flush with the floor.

Gage.

9. The tank should be equipped with a gage, indicator and float as shown.

Ladder.

10. The tank should be provided with a ladder as shown.

Concrete.

11. The concrete in the floor, shell and roof shall be a thoroughly uniform and dense mixture of cement, sand, stone and

water, made and laid in accordance with the specifications of this Association for reinforced concrete. The volume of the sand shall be in excess of the voids in the stone. The volume of the cement shall be in excess of the voids in the evenly mixed sand and stone. The excess of sand and cement shall be such as will give the greatest attainable density in the concrete. The volume of water shall be sufficient to give the concrete a fluidity that will cause it to flow and mold itself into the forms readily and completely. An unnecessary quantity of water shall not be used. The engineer shall determine the above specified voids and proportions.

In the foundation, the concrete shall be mixed in the proportions specified by the engineer and it shall fulfill the requirements of the specifications for concrete of this Association.

Mixing.

12. The concrete should preferably be mixed by batch mixing machines. The method used shall yield a complete and even mixture.

Cleanliness.

13. All dirt and foreign matter shall be excluded from all materials, concrete and stages of the work.

Pouring and Mixing.

14. This concrete, after mixing, shall be poured and worked into final position in the forms before its initial set is complete, and it shall not thereafter be disturbed. As it is thus placed, it shall be thoroughly worked throughout by flat thin bladed tools in a manner that will eliminate all voids and air pockets and produce unbroken mortar faces against all forms and secure perfect contact with every part of all reinforcing rods therein.

Joints.

15. The surface of concrete in joints should be free of laitance and all foreign matter and should be rough, fresh, clean and wet when concrete is laid thereon. The surface should be covered with a heavy coat of grout or mortar immediately in advance of placing concrete thereon. The surface should be thoroughly tooled, scrubbed and washed preparatory to the application of grout and concrete. The new concrete should be worked into complete contact with the old concrete.

Muriatic acid or equivalent may be used as a help to the tooling and scrubbing, but all of the concrete penetrated by the acid should be entirely removed.

A metal dam of non-corrosive metal like copper should be inserted in the concrete joints intended to prevent the passage of water. The metal should be driven edgewise into the first half of the joint to a depth equal to half the width of the metal before the initial set of the concrete is complete. The contact between the concrete and the metal should be complete and perfect. The edges of the metal should be turned over 90 degrees for anchorage. Joints in the metal dam should be lapped at the ends in a manner that will secure water-tight joints.

This specification for joint does not necessarily and preferably may not apply to the joint between the floor and the foundation.

The entire process of making joints shall be as required.

Wetting.

16. Rapid drying out of concrete shall be prevented by regular, frequent and continued wetting of all exposed concrete surfaces until all danger of arresting setting and hardening is past.

Freezing.

17. Freezing of concrete before it has finally set shall be prevented.

Broken.

18. Any concrete broken or displaced in any manner after having set shall be removed from the work.

Cement.

19. The cement shall conform to the specifications of this Association for Portland cement. It shall retain its original purity and qualities until it is incorporated into this work. Deteriorated or otherwise damaged cement shall not be used.

Sand.

20. The sand shall be clean, sound and sharp and it shall be of graded sized grains giving a minimum of voids.

Stone.

21. The stone shall be clean, sound and durable. The word "stone," includes broken rock and gravel. The stone shall be of graded sizes giving a minimum of voids. All of it shall be able to pass through a circular hole having a diameter of ¾-in.

Water.

22. The water shall be clean and free from anything injurious to the concrete.

Forms.

23. The concrete forms should be made of dressed and matched lumber or of metal. They should be accurately made and erected, be watertight, and should have ample strength and rigidity to prevent bending and warping under the load and action of the concrete. They should be erected in such manner as will permit the concrete to be poured and worked as above specified.

Pointing.

24. Any break in the concrete surfaces, not impairing the integrity of the structure, shall be pointed by cement mortar as the engineer shall direct. Any other imperfections in the concrete shall be treated and remedied as the engineer shall direct.

Reinforcement.

25. The concrete shall be reinforced by metal rods of the kind, form, size, number and arrangement as shown. They shall be maintained in required position as they are buried in the concrete, at which time they shall be free from dirt, paint, oil, grease and scale. Splices in a line of rods shall be lapped far enough to develop the full strength of each rod. Throughout the splice, the ends of the rods making it shall be far enough apart to develop maximum total adhesion of the concrete. Unnecessary splicing shall be avoided. No splice shall be opposite a splice in an adjacent line of rods.

Reinforcing Rods.

26. The rods shall be metal rods, plain or deformed. Their tensile strength shall be not less than 50,000 lbs. per sq. in. Their elastic limit shall not be less than 30,000 lbs. per sq. in. Their ductility shall be such that any rod can be bent 180 degrees on a radius equal to 2 diameters or sides of the rod without sign of fracture.

Stresses.

27. Assuming the metal rods to carry the water pressure and other stresses without aid from the tensile strength of the concrete, the stress per sq. in. in the rods should not exceed 10,000 lbs. Vertical reinforcement in the shell, between the shell and the foundation and across joints in the concrete should be ample to prevent opening of cracks in the concrete. Reinforcement in all necessary directions should be ample to prevent as far as practicable the opening of cracks in the concrete due to its shrinkage in setting to its stretching under the water load. The minimum thickness in inches of concrete at any point should be such that when the water load in pounds at that point is diminished by 3,000 times the sectional area in sq. in. of the metal reinforcement at that point, the remaining water load will stress the concrete not more than 300 lbs. per sq. in. at that point, provided that in no case shall the thickness be less than 4 in.

Loading.

28. The weight of water should be assumed to be 63 lbs. per cu. ft. Wind pressure, acting in any direction, should be assumed to be, in pounds, 30 times the product of the height by two-thirds of the diameter of the tank in feet.

Waterproofing.

29. A uniformly dense mixture of concrete as herein specified should be the primary expedient to secure water-tight concrete. This may be supplemented by mixing with the concrete some form of waterproofing compound of proved efficiency or by washing the concrete surface therewith, or by both.

The engineer shall select the waterproofing material and determine the proper proportions and methods of application.

Waterproofing by the application of rich cement mortar may be acceptable if the foregoing specification for making joints in concrete work is complied with.

GENERAL SPECIFICATIONS FOR ORDINARY STEEL WATER AND OIL TANKS.

(Revised November, 1911.)

Ordinary Tanks Defined.

1. Ordinary tanks are those requiring plates not more than ⅝-in. thick.

Scope of Specifications.

2. These specifications cover ordinary steel tanks commonly used by railways for usual service conditions only.

Quality of Metal.

3. The metal in these tanks shall be a special refined steel or open-hearth steel.

lbs. per sq. in. It shall contain of

not less than 50,000 lbs. and an elastic limit not less than 30,000

The special refined steel shall have a tensile strength per sq. in.

Sulphur	Not more than .02 per cent.
Phosphorus	Not more than .005 per cent.
Manganese	Not more than .00 per cent.
Silicon	Not more than .00 per cent.

The open-hearth steel shall conform in physical and chemical properties to the specifications of this Association for steel bridges.

Carbon	Not more than .02 per cent.

For plates not more than ⅛-in. thick, ⅝-in. rivets shall be used. For thicker plates the diameter shall be ¾-in

Loading.

4. The weight of water shall be assumed to be 63 lbs., crude oil 56 lbs., and creosote oil 60 lbs. per cu. ft. Wind pressure, acting in any direction, shall be assumed to be, in pounds, 30 times the product of the height by two-thirds of the diameter of the tank in feet.

Unit Stresses.

5. Unit stresses shall not exceed the following:

(a) Tension in plates, 15,000 lbs. per sq. in. on net section.
(b) Shear in plates, 12,000 lbs. per sq. in. on net section.
(c) Shear on rivets, 12,000 lbs. per sq. in. on net section.
(d) Bearing pressure on field rivets, 20,000 lbs. per sq. in.

Cylindrical Rings.

6. Plates forming the shell of the tank shall be cylindrical and of different diameters, in and out, from course to course.

Workmanship.

7. All workmanship shall be first class. All plates shall be beveled on all edges for caulking after being punched. The punching shall be from the surface to be in contact. The plates shall be formed cold to exact form after punching and beveling. All rivet holes shall be accurately spaced. Drift pins shall be used only for bringing the parts together. They shall not be driven with enough force to deform the metal about the holes. Power riveting and caulking should be used. A heavy yoke or pneumatic bucker shall be used for power driven rivets. Riveting shall draw the joints to full and tight bearing.

Caulking.

8. The tank shall be made water or oil tight by caulking only. No foreign substance shall be used in the joints. For water tanks, the caulking shall preferably be done on the inside of tank and joint only; but for oil tanks the caulking should be done on both sides. No form of caulking tool or work that injures the abutting plate shall be used.

Minimum Thickness of Plates.

9. The minimum thickness of plates in the cylindrical part of the tank shall not be less than ¼-in. and in flat bottoms not less than 5-16-in. In curved bottoms the thickness of plate shall be not less than that of the lower plate in the cylindrical part.

Horizontal and Radial Joints.

10. Lap joints shall generally be used for horizontal seams and splices and for radial seams in curved bottoms.

Vertical Joints.

11. For vertical seams and splices, lap joints shall be used with plates not more than ⅝-in. thick. With thicker plates, double butt joints with inside and outside straps shall generally be used. The edge of the plate in contact at the intersection of horizontal and vertical lap joints shall be drawn out to a uniform taper and thin edge.

Rivet Holes, Punching and Pitch.

12. The diameter of rivet holes shall be 1/16-in. larger than the diameter of the rivets used. The punching shall conform to the specifications of this Association for such work on steel bridges. A close pitch, with due regard for thickness of plate and balanced stress between tension on plates and shear on rivets, is desirable for caulking.

Tank Support.

13. If the tank is supported on steel columns with bracing, the metal in such substructure shall conform to these specifications, and the anchorage and workmanship thereof shall conform to the specifications of this Association for the manufacture and erection of steel bridges.

Painting.

14. In the shop the metal shall be cleaned of dirt, rust and scale and, except the surfaces to be in contact in the joints of the tank, shall be given a shop coat of paint or metal preservative selected and applied as specified by the company.

After being completely erected, caulked and cleaned of dirt, rust and scale, all exposed metal work shall be painted or treated with such coat or coats of paint or metal preservative as shall be selected by the railway company.

Plans and Specifications.

15. Under these specifications and in conformity thereto the railway company shall cause to be prepared or shall approve detailed plans and specifications for such tanks, herein specified, as it shall construct. Such plans and specifications shall cover all necessary tank auxiliaries.

Conclusion.

That the specifications for steel, water and oil tanks is good practice, and should be included in the Manual.

Discussion.

Robert Ferriday.—We wish to make a number of changes in the specifications. The title should be "General Specifications for Steel and Water Tanks." Paragraphs (1) and (2) are to be combined under "Scope of Specifications." (1) is to read "These specifications are for steel tanks requiring plates not more than ⅝-in. thick." Since (1) and (2) are combined, numbers of all succeeding paragraphs are to be changed. (3) is to read: "2. The metal in these tanks is to be open-hearth steel."

W. F. Steffens.—I would like to know why the Committee, in paragraph (5) has not used the same unit stresses as are used for bridge design.

Robert Ferriday.—The material is under much different conditions of service, and we think the stresses specified are as large as safe to make them.

W. F. Steffens.—I would suggest that these stresses be expressed as a ratio of the stresses used in bridge design, especially since designs for both are made up by same department.

Robert Ferriday—I don't think such a reference would be satisfactory. I think it has been the practice of Committees to refer to other specifications only for the sake of brevity.

Geo. H. Bremmer.—It is entirely proper to refer to other parts of the manual. However, I think the Committee should give us one specification and refer to the paragraph numbers of the Bridge Specifications which relate to the tank specifications.

J. B. Berry.—I believe that this Committee should make up a list of tools necessary when putting up a tank. We have made up such a list, because there was none available.

A motion was made and carried that the specifications as amended be adopted.

MASONRY.

G. H. Tinker, Chairman; F. L. Thompson, vice-chairman; G. J. Bell, H. E. Boardman, C. W. Boynton, T. L. Condron, L. D. Crear, L. N. Edwards, A. H. Griffith, L. J. Hotchkiss, Richard L. Humphrey, W. H. Petersen, Philip Petri, J. H. Prior, F. E. Schall, G. H. Scribner, Jr., A. N. Talbot, Job Tuthill, A. A. Wirth.

Revision of the Manual.

The Committee recommends no changes in the Manual at this time.

Waterproofing of Masonry.

In accordance with instructions from the Board of Direction, the investigation of the waterproofing of masonry has been continued during the past year. A circular letter requesting information relative to this subject was sent to the members of the Association. The circular letter followed, in the main points, the circulars issued in former years, adding such additional questions as appeared to your Committee called for in the light of present day practice.

The replies were quite numerous, but only a limited number contained information on the subject under consideration.

Abstracts from some of the replies containing information pertinent to the subject are appended; a perusal of these brings out the fact that while considerable waterproofing is being done throughout the country, the methods followed and materials used are much the same as described in previous reports of the Committee.

From several replies it will be seen that impervious concrete can be made without special waterproofing, by using a suitable gradation of aggregates and the proper amount of cement and reinforcing the concrete to counteract temperature and shrinkage stresses, and in depositing to use the proper care and amount of work to secure a dense concrete.

It will also be noticed that in using waterproofing material such as felt, in connection with coal-tar pitch or asphaltum, fair results are obtained, when the weather conditions are favorable, and when the work can be done without interference or obstructions and by working continuously until completed; it is also noticed that when the work is done at an unfavorable season, or when work is done in distinct separate periods and sections, under difficulties such as track operations, undue haste in completing the work necessitated by special circumstances, the results have generally been unsatisfactory.

The Committee has not prepared a final report on the subject of waterproofing; the appended abstracts are submitted as information.

New York Central & Hudson River.

Mr. George W. Kittredge, Chief Engineer, furnishes the following information:

General Remarks: Trouble experienced in the case of felt and coal-tar pitch is mostly on account of the poor class of labor used. It does not prevent leakage when the body walls are not built continuously. Trouble is also caused by lack of care in joining successive sections of work, horizontally or vertically.

Subway at Passenger Station—Buffalo.

The subway leading from the Buffalo Passenger Station is of rectangular section, 20 ft. in width and 7 ft. in height inside, serving 12 tracks. The side walls are of monolithic construction similar to ordinary retaining walls, and the floor is extra thick of the same construction. The roof is of 20-in. I-beams, with concrete filling between, covered with three inches of cement, with waterproofing and with a protection of brick on top of this and under the ballast. The entire outside of walls was covered with waterproofing consisting of 6-ply tarred felt, each layer put on separately, with Sarco compound, and outside of this the side walls and the top are protected with brick laid in cement. The floor is protected by 6-in. layer of concrete under the waterproofing, the floor itself above the waterproofing being 10 in. thick, the extra weight being given to prevent floatage, and prevent its being cracked by the upward pressure of the water. Waterproofing of sides and floor was made continuous as far as possible.. The

conditions requiring waterproofing were as follows: This construction is in a bed of clay which extends about half way up the height of the subway, the remaining 6 ft. or so is of a loose gravel, so that all of the surface water coming through the porous matter is held by the clay under slight head.

The construction of this work was carried on under considerable difficulty, it being necessary to work while the traffic, which is very heavy at this point, was going on, and it was possible to build only a part of the subway at a time, and not make a continuous job of it. It is probable that at points where one piece of work left off, and another began, the connection between the waterproofing was imperfect, as cracks began to develop, and the water came into the subway in small quantities in numerous places almost as soon as completed. This was remedied by careful application of ½-in. hydrolithic cement by the Waterproofing Company, on the inside of the subway, so that the structure is now tight, except the roof, where on account of the vibration of the trains, it was practically impossible to insure an absolutely tight job. Great care was taken to find all cracks and dig them out, and fill them with hydrolithic cement. The cost of the hydrolithic waterproofing was about 30 cents per sq. ft., and has now been on for two years, and has given good satisfaction.

Referring to letter of September 16, 1911, in the matter of waterproofing of masonry: I sent on February 10 last considerable information on this subject and at this time can only add a few remarks in regard to waterproofing which we found on the old Park Avenue tunnel roof where a portion of it was removed at 59th Street.

The roof consisted of iron beams with brick arches which were leveled up with concrete. The waterproofing was placed directly on this concrete and was covered with about two ft. of earth

G. H. Tinker, Chairman Committee on Masonry.

which formed the soil for the parking around the openings in the roof of the tunnel. Drains were provided so that the water did not stand in the earth. The materials were of felt and coal-tar pitch, three plies of felt being used. We have no information as to the method of application or the cost of the work. I have understool indirectly that this waterproofing was placed when the tunnel was built, some forty years ago. From recollection of the tunnel for the past ten years the vegetation over this waterproofing was in such a state that the waterproofing must be at least twenty years old. The waterproofing was removed on account of changes we were making last winter, and it was in fair condition. The paper had become somewhat brittle, also the pitch was harder than pitches we apply now, but the sheet of waterproofing was intact and capable of shedding water. Small leaks would not have been detected; the only protection of the concrete was the soil placed over it. The waterproofing covered the tunnel roof from 58th to 59th Street, and presumably extends a good deal farther. There was no provision for expansion joints.

Michigan Central.

(A) Fifteenth Street Bridge, 3 spans, through plate girders, I-beam plate ballast floor; masonry abutments.

(B) Twenty-fourth Street Bridge, 3 spans, I-beam plate ballast floor on steel bents; masonry abutments.

(C) Vinewood Avenue Bridge, 3 spans, I-beam plate ballast floor bridge on steel bents and masonry abutments.

(D) Scotten Avenue Bridge, same as Vinewood Avenue.

(E) Clark Avenue Bridge, same as Vinewood Avenue.

(F) Twenty-third Street Bridge, same as Vinewood Avenue.

(G) Sixteenth Street Bridge, same as Fifteenth Street.

(H) Fourteenth Street Bridge, same as Fifteenth Street.

(I) Beaubien Street Bridge Peninsular Spur, same as Fifteenth Street.

(J) Brush Street Bridge Peninsular Spur, same as Fifteenth Street.

(K) Beaubien Street Bridge, 3 spans, built up beams on concrete bents and concrete abutments. Beams embedded in concrete.

(L) Brush Street Bridge, 3 spans, Bethlehem beams on concrete bents and abutments. Beams embedded in concrete.

(M) John R. Street Bridge, same as Brush Street.

(N) Tecumseh Road, one 75-ft. through girder span with I-beam floor and concrete slab on top of I-beams.

(O) Beecher Avenue Bridge, 3 spans, built up beams with plate, ballast floor, on steel bents and concrete abutments.

(P) Twentieth Street Bridge, same as Beecher Avenue.

(R) Military Avenue Bridge, same as Beecher Avenue.

(S) Livernois Avenue Bridge, same as Beecher Avenue.

All the structures mentioned above required waterproofing to keep floor dry over the streets as follows:

For (A), (B), (C), (D) and (E): Mop coat of Sarco with 1½-in. sand and Sarco mastic and pouring coat of No. 6 Sarco on top of mastic.

For (F): Mop coat of Sarco, 1½ in. sand and pitch mastic to cover rivet heads, on top of this 5-ply Barrett Felt and pitch protected by 1½ in. pitch Torpedo gravel mastic.

For (G): Mop coat of Sarco, 1½ in. sand and Sarco mastic to cover rivet heads, 2-ply Barrett Felt mopped with Sarco No. 6, 1½ in sand and Sarco mastic. Pouring coat of Sarco.

For (H): Mop coat of Sarco, 1 in. coat of sand and Barrett pitch to cover rivet heads, 5-ply Barrett Felt mopped with pitch, 1½ in. of Torpedo gravel pitch mastic with pouring coat of Barrett pitch.

For (I), (J), (K), (L) and (M): Paint with Sarco Primer, 3-ply, 8 oz. Burlap mopped with Sarco No. 6, 1½ in. Sarco mastic, pouring coat of Sarco No. 6.

For (N): Paint coat of Sarco Primer, 3-ply, 8 oz. Burlap mopped with hot Sarco No. 6, 1½ in. protection coat of Sarco mastic and Torpedo gravel.

For (O) and (P): One and one half in. Sarco sand and mastic, 3-ply 8 oz. Burlap mopped with No. 6 Sarco; 1½ in. Sarco Torpedo gravel mastic and pouring coat of hot mastic.

For (R) and (S): One and one-half in. sand pitch mastic, two layers of felt mopped with Barrett Pitch and one layer of reinforcing felt mopped with Barrett Pitch; 1 in. Barrett sand and pitch protection coat.

COST PER SQUARE FOOT OF SURFACE COVERED.

	Labor	Material	Total	Completed
(A)	3-9/10	5-5/10	9-4/10	August, 1908
(B)	3-9/10	6-4/10	9-3/10	June, 1909
(C)	2-7/10	6-9/10	9-6/10	September, 1908
(D)	2-5/10	7-2/10	9-7/10	June, 1908
(E)	3-2/10	7-8/10	11	June, 1908
(F)	7	7-4/10	14-4/10	June, 1909
(G)	4-7/10	9-7/10	14-4/10	August, 1908
(H)	7-5/10	6-8/10	14-3/10	July, 1908
(I)	20	16-4/10	36-4/10	Done in winter; trouble with snow and ice. December, 1910
(J)	9-3/10	16-9/10	36-2/10	December, 1910
(K)	6-4/10	14-4/10	20-8/10	December, 1910
(L)	9-5/10	15-5/10	25	March, 1911
(M)	8-5/10	17-1/10	25-6/10	January, 1911
(N)	10	8-6/10	18-6/10	June, 1910
(O)	7-3/10	18-8/10	26-1/10	November, 1910
(P)	7-2/10	16-2/10	23-4/10	July, 1910
(R)	4-6/10	10	14-6/10	May, 1910
(S)	5-8/10	10-8/10	15-6/10	May, 1910

(A) Leaks badly over posts at gusset plate connections and small leaks at nearly all beam connections in northbound track. Leaks at 25 per cent. of beam connections in southbound track.

(B), (C), (D), (E) and (F). No leaks.

(G) Leaks over posts at gusset plate connections only.

(H) Leaks over posts at gusset plate connections only.

(I), (J), (K), (L) and (N). No leaks.

(O) Two small leaks over supporting girder, third panel from north end.

(P), (R) and (S). No leaks.

(Additional letters from this report will appear in a later issue.)

Methods of Depositing Concrete Under Water.

Pursuant to the instructions of the Board of Directors, letters and circulars of inquiry were sent to the members of the Association, requesting information on the subject of "Methods of Depositing Concrete Under Water." This inquiry embodied the following questions:

(1) Methods used for depositing concrete.
(2) Depth of water.
(3) Results.
(4) Precautions necessary to secure desired results.
(5) A statement of the cost of plant and relative cost of depositing concrete per cubic yard, as compared with concrete deposited by the usual methods, will be of value in this investigation.

Seventy-one replies were received, fifty-six of which contain information of value, covering nine methods of depositing, viz., bottom-dump bucket, tremie (a closed chute), sacks, sacks withdrawn, paper bags, open chutes, open depositing, pneumatic grouting of broken stone, concrete blocks. From an examination of the replies, the committee draws the following:

Conclusions.

(1) Concrete may be deposited successfully under water, if so handled as to prevent the washing of the cement from the mixture.

(2) Cofferdams should be sufficiently tight to prevent current through the pit, and the water in the pit should be quiet.

(3) The concrete should be deposited in place either by means of a drop-bottom bucket or a tremie, and should not be allowed to fall through the water.

(4) Where a bucket is used, it should be carefully lowered to the bottom and raised to the surface, so as to cause as little disturbance as possible of the water.

(5) Where a tremie is used, it should be kept filled with concrete up to the top of the water level, and the discharge end should be kept buried in the freshly deposited mass to prevent emptying, and raised a few inches at a time as the filling progresses.

(6) The surface of the concrete must be kept as nearly level as possible to avoid the formation of pockets which will retain laitance and sediment.

(7) Where concrete is not deposited continuously, all sediment should be removed from the surface of the concrete, by pumping or otherwise, before depositing fresh concrete.

(8) The concrete should be a 1:2:4 mixture and of a "quaking" consistency.

(9) Freshly deposited concrete should not be disturbed.

(10) Where the flow of water through the pit cannot be prevented, concrete should be deposited in cloth sacks.

Report of Work of Joint Committee on Concrete and Reinforced Concrete.

The Joint Conference on Concrete and Reinforced Concrete held a meeting at Atlantic City, June 30, 1911, at which time the work of the committee was gone over and the previous record carefully studied, with the view of putting it in shape for final report.

The work of revising the report was allotted to a number of sub-committees. Although these committees have reported back and the data put in shape to again present to the committee as a whole, the meeting has not been called for ratification of the report; therefore, your committee can only present a progress report, believing that the work of the Joint Committee on Concrete and Reinforced Concrete will be finished some time during the present year.

Unification of Portland Cement Specifications.

(Specifications for Natural Cement were not considered.)

Early in the year 1911 two Government Boards or Committees were appointed to deal with the question of Cement Specifications. One of these, appointed by the Chief Engineer of the United States Army, was instructed to revise Professional Papers No. 28; the other was made up of representatives from the various departments, appointed by the head of each department. This committee was instructed to prepare and report to the departments a single Standard Specification for the Government. This body was known as "The Department Committee for the Unification of Government Specifications for Portland Cement."

On September 12 the Army Board held a meeting at which representatives from the various engineering bodies interested in cement specifications, from the Association of American Portland Cement Manufacturers and representatives from one or two commercial laboratories, were in attendance. At this meeting the Army Board received suggestions for the revision of Professional Papers No. 28.

Following this meeting the Department Committee issued a tentative specification, which was sent out with request for criticism and suggestion.

On November 24 a meeting was held at Washington which was attended by representatives from the Departmental Committee, the Army Board and the American Railway Engineering Association. Committee C-1, American Society for Testing Materials, and Committee on Uniform Tests for Cement, American Society of Civil Engineers, were not represented, though they had previously accepted the invitation to be present. It was apparent that the tendency of the Departmental Committee was to adhere quite closely to the standard adopted by the American Society for Testing Materials, which is also the standard of this Association.

On November 27 a meeting was held in Philadelphia, attended by representatives from the Committee on Uniform Tests for Cement, American Society of Civil Engineers, Standard Specifications for Portland Cement (C-1), American Society for Testing Materials, and through its membership on Committee C-1 this Association was represented. The Association of American Portland Cement Mannufacturers and the Departmental Committee were also represented. The principal question before this meeting was that of Uniform Methods, and an agreement was reached on every point excepting the use of the Vicat Needle vs. Gilmore Needle in determining time of set, and Vicat Needle vs. Ball Test in determining normal consistency.

On January 8, 1912, representatives from the Departmental Committee and Committee on Uniform Tests for Cement of the American Society of Civil Engineers met with the Army Board to further consider the points of difference in the respective specifications. Agreement had been reached upon all points excepting those previously mentioned, and at this meeting the representatives of the American Society of Civil Engineers expressed preference for retaining the Vicat Needle, but offered to compromise and accept the Ball Method as the means of determining normal consistency if the Government representatives would accept the Vicat Needle as the method of determining the time of set.

After due consideration the Government representatives were convinced that the Gilmore Needle should be retained in their specifications; also, that the Ball Test for determining normal consistency is preferable to the Vicat Needle, and a specification which agrees with the standard of this Association in other particulars was approved by the Departmental Committee and the Board of Engineer Officers and recommended for adoption as a United States Government Standard Specification for Portland Cement.

The Committee on Uniform Tests for Cement, upon making their report to the American Society of Civil Engineers in January, stated that they had been unable to get together with the Army Board and the Departmental Committee on Methods of Tests, and, considering their work finished, asked to be dismissed. The committee was accordingly relieved from further duty.

Conclusions.

Your committee recommends the adoption of the following conclusions:

(1) That the conclusions in reference to Methods of Patching and Repairing Plain and Reinforced Concrete is approved as good practice.

(2) That the conclusions in reference to Methods of Depositing Concrete Under Water be approved as good practice.

Discussion.

Conclusions 1, 2, and 3, with respect to "Patching and repairing plain and reinforced concrete," were passed without discussion.

P. C. Newbegin—Why does the committee in one case recommend mortar of same consistency as the structure, and not in the other case?

G. H. Tinker—There is no very good reason for that. We do not want a rich mortar, as it is liable to crack.

G. H. Tinker—Paragraph 6 refers more especially to a rather thick block of concrete, such as a replaced bridge seat, which might be 6 ft. thick.

E. V. Smith—I would like to know the number and size of dowels which would be required in (5) and (6).

G. H. Tinker—That would be regulated by the size of the patch. Enough dowels should be imbedded to resist the shrinking stresses.

Hunter McDonald—I wish to inquire if the committee has investigated any of the patented patching methods. There is one similar to the old rust joint. The mixture used consists of 48 per cent iron filings, 48 per cent Portland cement, and 2 per cent sal ammoniac, and sells at 5c per lb.

G. H. Tinker—We did not consider patented methods; there are a number of such methods for making a foreign substance adhere to concrete. The cost of the mixture mentioned is 15 times the cost of Portland cement, and we consider the cement good enough.

Hunter McDonald—If the committee is absolutely sure they have the best and most efficient method, then the report is all right. If the patented methods are superior we should know it.

L. G. Curtis—I would like to inquire if the committee investigated Ransomite, used to prepare the surface for a patch. This material has given us good results on the B. & O.

G. H. Tinker—This question was considered in the preliminary report, along with a number of others. We think the steam jet gives the best results.

The conclusions for this part of the report were accepted.

Conclusions (1) and (2) "Depositing concrete under water" were adopted.

C. E. Lindsay—Does paragraph (3) exclude all other methods?

G. H. Tinker—The methods mentioned are preferable for large jobs, but other systems are not excluded.

C. E. Lindsay—I have in mind a place where we were very successful placing concrete in sacks.

R. D. Coombs—Is it necessary to specify the exact mixture? Are there not cases where a leaner mixture could be used?

G. H. Tinker—A leaner mixture might be successful. On account of currents, however, we think it best to make the richer mixture and allow for some of the cement being washed away.

A suggestion was made to insert at the beginning of paragraph (10), "In open water or." This suggestion was accepted by the committee.

The conclusions for "Depositing concrete under water" were adopted for publication in the manual.

RECORDS AND ACCOUNTS.

H. J. Pfeifer, Chairman; M. C. Byers, Vice-chairman; J. M. Brown; Edw. Gray; E. E. Hanna; Henry Lehn; J. H. Milburn; C. W. Pifer; Guy Scott; W. A. Christian; G. J. Graves; C. W. Cochran; G. T. Warren; H. Stephens.

The Board of Direction assigned the following work for the current year:

(1) Make a comprehensive study of the forms in the Manual which were adopted a number of years ago.

(2) Study the economical way of managing a storehouse so as to assure a minimum stock of materials at all times.

(3) Make concise recommendations for next year's work.

The following Sub-Committees were appointed:

Sub-Committee A—Study of Forms in Manual: C. W. Cochran, Henry Lehn, J. H. Milburn, Guy Scott, H. Stephens, G. T. Warren.

Sub-Committee B—Economical Storehouse Management: J. M. Brown, W. A. Christian, G. J. Graves, Edw. Gray, E. E. Hanna, C. W. Pifer.

The Committee devoted by far the greatest part of its time to subject (2), the first point discussed relating to the scope of the instructions as follows: Should the internal economy of the storehouse be solely considered, or should the effects of storehouse management on the broader economies of maintenance and operation be also taken into consideration. As the first involves a storekeeping rather than a maintenance or operating problem, the Committee decided to base its investigation and report on the second interpretation.

Material and labor are required in the construction, maintenance and operation of railroads; and since it is impossible to secure materials when, and in the quantities required, by direct purchase, a reserve stock is accumulated which is drawn upon to meet the demands as they arise.

The following figures are taken from the report of the Interstate Commerce Commission for the year ending June 30, 1909:

Operating expenses of the railroads of the United States for the year ending June 30, 1909, amounted to $1,599,443,410 (p. 75).

Machinists, carpenters, other shopmen, section foremen, other trackmen, other employes and laborers, whose efficiency depends to a great extent on their having proper materials and tools, received in wages $466,138,215, or about 29 per cent. (p. 46) of the entire operating expenses.

The general balance sheet for the same period gives the value of materials and supplies on hand at $206,849,619 (p. 82). Five per cent. per annum on this sum is $10,342,481, about 2.2 per cent. of what was paid during the year to the classes of employes above mentioned.

Assuming that it is possible to reduce the stock on hand to the extent of 50 per cent., the saving per annum would be only 1.1 per cent. of the amount paid annually in wages to the above mentioned employes, so that even a slight loss in their efficiency through faiure to secure materials and tools as required, will soon absorb much more than the amount saved by reduced investment in stock. It would seem, therefore, that the most important function of a storehouse is the prompt delivery of materials and tools so that delays to labor resulting from their lack may be reduced to a minimum.

Conclusions.

It is recommended—

(1) That no changes be made in the forms appearing in the Manual.

(2) That the following statement embodies the general principles governing the economical management of a railway storehouse:

Reasons for Maintaining a Storehouse.

The object of a storehouse is to provide material and tools when required so that the cost of work may be minimum, bearing in mind the factors of delay to work or labor, also interest on investment in stock.

The following essential elements enter into the problem:

(a) Standardization.—The standardization of materials and instructions in regard to their use will reduce to a minimum the number of items of material of the various classes which should be carried in stock. The amount of each item which should be carried in stock will depend upon the rate of consumption, time required for the purchase and delivery of material, and also upon local conditions.

(b) Classification of Material.—This is necessary so as to reduce to a minimum the cost and time of handling. An approved classification should be followed in making requisitions.

(c) Stock Account.—An account should be kept of stock showing at all times a record of receipts, disbursements and amount on hand. Stock should be replenished when the amount of any item has been reduced to a fixed minimum. Inventories should be made at stated periods. A proper stock account furnishes a check on excessive supply and obsolete material.

(d) Distribution.—When material is shipped, notice should be sent to consignee showing partial or complete filling of requisition and if partial, when final shipment may be expected.

(e) Organization.—The storekeeper's place in the general organization should be so fixed and adjusted that the measure of his efficiency is primarily, the promptness and accuracy with which he fills requisitions, and, secondly, his ability to hold down the stock investment to the lowest amount consistent with the first requirement.

The conclusions were adopted without discussion.

ELECTRICITY.

George W. Kittredge, Chairman; J. B. Austin, Jr., Vice-Chairman; R. D. Coombs; A. O. Cunningham; L. C. Fritch; George Gibbs; G. A. Harwood; E. B. Katte; C. E. Lindsay; W. S. Murray; J. R. Savage; W. I. Trench; H. U. Wallace.

George W. Kittredge, Chairman Committee on Electricity.

The Association directed that the outline of Committee work for the year 1911 be as follows:

(1) Continue the consideration of the subject of Clearances.

(2) Continue the preparation of Standard Specifications for Overhead Transmission Line Crossings.

(3) Report on effect of electrolytic action on metallic structures and best means of preventing it.

(4) Method of insulation and protection.

In accordance with the instructions of the Board of Direction, that two subjects would be the maximum for the action of the convention, your Committee has confined itself to the following subjects:

(1) Clearances.

(2) Transmission Lines and Crossings.

Clearances.

At the last meeting of the Association at which our report was considered it was decided that in view of the fact that the American Railway Association had a Committee on Clearance Lines and the American Electric Railway Engineering Association also had a Committee on Clearance Lines, and because of the fact that the Committee on Electricity had not been able for various and

sundry reasons to reach conclusions with them and agree upon lines satisfactory to all concerned, to accept the report on clearance as one of progress only, with the idea of prior to the next meeting agreeing with the other associations mentioned upon lines that would be satisfactory to all.

The chairman of the Sub-Committee on Clearances has subsequently been in communication with representatives of the committees of the other two associations mentioned with the result that the diagram "A," shown on page 525, is now submitted as the recommended clearance lines for equipment and permanent way structures adjacent to third rail and for third rail structures.

It it believed that similar diagrams will be recommended to the American Railway Association by the Committee on Electric Working and by the Committee considering the subject of Clearance of the American Electric Railway Engineering Association.

Diagrams have been obtained from all the principal railways in the United States using third rail showing outlines of their third rail structures and from some of the principal steam railroads diagrams showing outlines of maximum equipment. These various diagrams are made a part of this report and were used as a basis in establishing clearance lines for third rail structures, permanent way structures adjacent to third rail and equipment.

It should be noted that out of a total mileage of 1,988.04 using steam and electricity, 973.80 miles will clear the lines as shown in the diagram. It will also be noted that the mileage not clearing is mainly interurban electric roads which handle steam equipment as secondary traffic and elevated roads in cities which do not handle steam equipment.

At the last meeting of the Association the definition for "Third Rail Gage" as follows was adopted:

"Distance, measured parallel to plane of top of both running rails, between gage of running rail and center line of third rail."

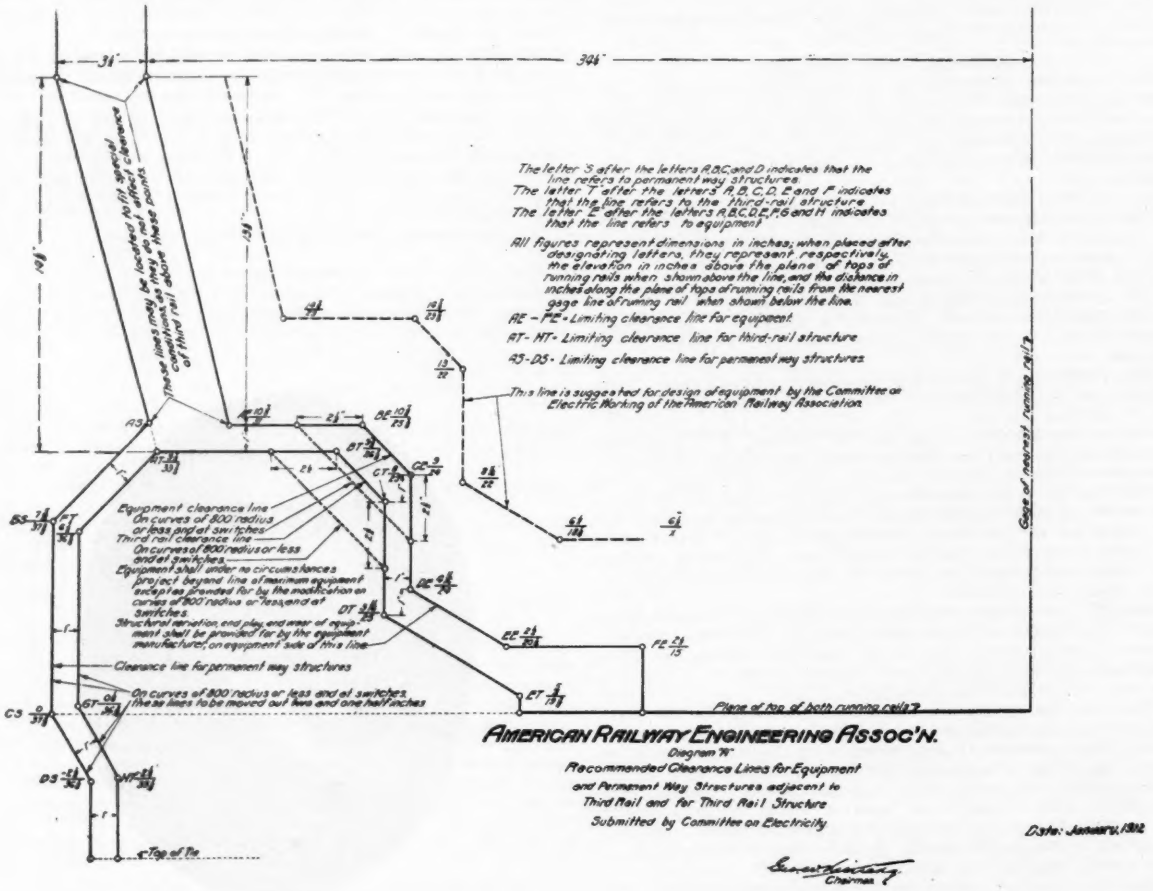
It is now proposed changing the definition to read as follows:

"Third Rail Gage.—Distance measured parallel to plane of top of both running rails between gage of nearest running rail and inside gage line of third rail."

Transmission Lines and Crossings.

The Sub-Committee Chairman, Mr. Coombs, has been working in conjunction with Committees of the National Electric Light Association, American Institute of Electrical Engineers, American Electric Railway Association, Association of Railway Telegraph Superintendents, and representatives of the telephone and telegraph companies, in connection with the preparation of specifications for overhead crossings of electric light and power lines, and the following specification is submitted which is identical with the specifications that have been adopted by the other associations mentioned, excepting in paragraphs Nos. 10, 13, 18, 24, 29, 31, 32, 34, 45, 49, 51, 55, 60 and 61, which changes it will be noted by comparing the specifications are in line with more clearly expressing the condition or of making them more satisfactory from the point of view of the railroads.

For the convenience of the members the paragraphs mentioned are given as Appendix "B" to this report in the form in which they have been adopted by the other associations mentioned above.


34"
344"
The letter S after the letters A,B,C and D indicates that the line refers to permanent way structures.
The letter T after the letters A,B,C,D, E and F indicates that the line refers to the third-rail structure.
The letter E after the letters A,B,C,D,E,F,G and H indicates that the line refers to equipment.
All figures represent dimensions in inches; when placed after designating letters, they represent, respectively, the elevation in inches above the plane of tops of running rails when shown above the line, and the distance in inches along the plane of tops of running rails from the nearest gage line of running rail when shown below the line.
AE - FE - Limiting clearance line for equipment.
AT - MT - Limiting clearance line for third-rail structure.
AS - DS - Limiting clearance line for permanent way structures.
This line is suggested for design of equipment by the Committee on Electric Working of the American Railway Association.
These lines may be located with special conditions as they do not affect clearance of third rail above these points.
Equipment clearance line - On curves of 800 radius or less and at switches.
Third rail clearance line - On curves of 800 radius or less and at switches.
Equipment shall under no circumstances project beyond line of maximum equipment except as provided for by the modification on curves of 800 radius or less and at switches.
Structural variation, end play, and wear of equipment shall be provided for by the equipment manufacturer, on equipment side of this line.
Clearance line for permanent way structures.
On curves of 800 radius or less and at switches, the as lines to be moved out two and one half inches.
Gage of nearest running rail
Plane of top of both running rails
Top of Tie
AMERICAN RAILWAY ENGINEERING ASSOC'N.
Diagram "A"
Recommended Clearance Lines for Equipment and Permanent Way Structures adjacent to Third Rail and for Third Rail Structure
Submitted by Committee on Electricity
Date: January, 1912.
Chairman

Recommendations.

(A) The Committee recommends for adoption by the Association:

(1) Definition: "Third Rail Gage.—Distance measured parallel to plane of top of both running rails between gage of nearest running rail and inside gage line of third rail."

(2) The lines shown on diagram "A" as equipment clearance lines.

(3) The lines shown on diagram "A" as permanent way structure adjacent to third rail clearance lines.

(4) The lines shown on diagram "A" as third rail structure clearance lines.

(5) The adoption of the Specifications for Overhead Crossings of Electric Light and Power Lines.

(B) The Committee recommends a continuation of work already outlined, particularly consideration of clearance for overhead third rail working conductors, electrolysis and insulation and the consideration of any new information that may develop in reference to maintenance organization and relation of track structures, and

asks for such other direction or instructions as seem necessary or desirable.

APPENDIX A.

Specifications for Overhead Crossings of Electric Light and Power Lines.

General Requirements.

Scope.

1. These specifications shall apply to overhead electric light and power line crossings (except trolley contact wires), over railroad right-of-way, tracks, or lines of wires; and further, these specifications shall apply to overhead electric light and power wires of over 5,000 volts constant potential, crossing, or constructed over telephone, telegraph or other similar lines.

Location.

2. The poles, or towers, supporting the crossing span preferably shall be outside the railroad company's right-of-way.

3. Unusually long crossing spans shall be avoided wherever practicable.

4. The poles, or towers, shall be located as far as practicable from inflammable material or structures.

5. The poles, or towers, supporting the crossing span, and the adjoining span on each side, preferably shall be in a straight line.

6. The wires, or cables, shall cross over telegraph, telephone and similar wires wherever practicable.

7. Cradles, or overhead bridges, shall not be used.

Clearance.

8. The side clearance shall be not less than 12 ft. from the nearest rail of main-line track, nor less than 6 ft. from the nearest rail of sidings. At loading sidings sufficient space shall be left for a driveway.

9. The clear headroom shall be not less than 30 ft. above the top of rail under the most unfavorable condition of temperature and loading. For constant potential, direct-current circuits, not exceeding 750 volts, when paralleled by trolley contact wires, the clear headroom need not exceed 25 ft.

10. The clearance of alternating-current circuits above any existing wires, under the most unfavorable condition of temperature and loading, shall be not less than 8 ft. wherever practicable. For constant potential, direct-current circuits, not exceeding 750 volts, the minimum clearance above telegraph, telephone and similar wires may be 2 ft. with insulated wires and 4 ft. with bare wires.

11. The separation of conductors carrying alternating current, supported by pin insulators, for spans not exceeding 150 ft., shall be not less than:

Line Voltage.	Separation.
Not exceeding 6,600 volts	14½ in.
Exceeding 6,600, but not exceeding 14,000	24 in.
Exceeding 14,000, but not exceeding 27,000	30 in.
Exceeding 27,000, but not exceeding 35,000	36 in.
Exceeding 35,000, but not exceeding 47,000	45 in.
Exceeding 47,000, but not exceeding 70,000	60 in.

For spans exceeding 150 ft. the pin spacing should be increased, depending upon the length of the span and the sag of the conductors.

Note.—This requirement does not apply to wires of the same phase or polarity between which there is no difference of potential. With constant potential, direct-current circuits not exceeding 750 volts, the minimum spacing shall be 10 in.

12. When supported by insulators of the disc or suspension type, the crossing span and the next adjoining spans shall be dead-ended at the poles, or towers, supporting the crossing span, so that at these poles, or towers, the insulators shall be used as strain insulators.

13. The clearance in any direction between the conductors nearest the pole, or tower, and the pole or tower shall be not less than:

Line Voltage.	Clearance.
Not exceeding 10,000 volts	9 in.
Exceeding 10,000, but not exceeding 14,000	12 in.
Exceeding 14,000, but not exceeding 27,000	15 in.
Exceeding 27,000, but not exceeding 35,000	18 in.
Exceeding 35,000, but not exceeding 47,000	21 in.
Exceeding 47,000, but not exceeding 70,000	24 in.

Conductors.

14. The normal mechanical tension in the conductors generally shall be the same in the crossing span and in the adjoining span of each side, and the difference in length of the crossing and adjoining spans generally shall be not more than 50 per cent. of the length of the crossing span.

15. The conductors shall not be spliced in the crossing span nor in the adjoining span on either side.

16. The method of supporting the conductors at the poles, or towers, shall be such as to hold the wires, under maximum loading, to the supporting structures, in case of shattered insulators, or wires broken or burned at an insulator, without allowing an amount of slip which would materially reduce the clearance specified in paragraphs No. 9 and No. 10.

Guys.

17. Wooden poles supporting the crossing span shall be side-guyed in both directions if practicable, and be head-guyed away from the crossing span. The next adjoining poles shall be head-guyed in both directions. Braces may be used instead of guys.

18. Strain insulators shall be used in guys from wooden poles carrying any power wire of less than 6,600 volts, provided the guys are not through grounded to permanently damp earth. Strain insulators shall not be used in guying steel structures, nor required on wooden poles carrying wires, all of which are 6,600 volts or more, provided the guys are through grounded to permanently damp earth.

Clearing.

19. The space around the poles, or towers, shall be kept free from inflammable material, underbrush and grass.

Signs.

20. In the case of railroad crossings, if required by the railroad company, warning signs of an approved design shall be placed on all poles and towers located on the railroad company's right-of-way.

Grounding.

21. For voltages over 5,000 volts, wooden crossarms, if used, shall be provided with a grounded metallic plate on top of the arm, which shall be not less than ⅛-in. in thickness and which shall have a sectional area and conductivity not less than that of the line conductor. Metal pins shall be electrically connected to this ground. Metal poles and metal arms on wooden poles shall be grounded.

22. The electrical conductivity of the ground conductor shall be adjusted to the short-circuit current capacity of the system and shall be not less than that of a No. 4 B. & S. gage copper wire.

Temperature.

23. In the computation of stresses and clearances, and in erection, provision shall be made for a variation in temperature from —20 degrees Fahrenheit to +120 degrees Fahrenheit. A suitable modification in the temperature requirements shall be made for regions in which the above limits would not fairly represent the extreme range of temperature.

Inspection.

24. If required by contract, all material and workmanship shall be subject to the inspection of the company crossed; provided, that reasonable notice of the intention to make shop inspection shall be given by such company; if such notification is not given, the company crossed shall be furnished with certified reports of shop inspection of material and workmanship made by a properly qualified inspector. Defective material shall be rejected, and shall be removed and replaced with suitable material.

25. On the completion of the work, all false work, plant and rubbish, incident to the construction, shall be removed promptly and the site left unobstructed and clean.

Drawings.

26. If required, by contract, ... ( ) complete sets of general and detail drawings shall be furnished for approval, before any construction is commenced.

Loads.

27. The conductors shall be considered as uniformly loaded throughout their length, with a load equal to the resultant of the dead load plus the weight of a layer of ice ½-in. in thickness, and a wind pressure of 8 lbs. per sq. ft. on the ice-covered diameter, at a temperature of 0 degrees Fahrenheit.

28. The weight of ice shall be assumed as 57 lbs. per cu. ft. (0.033 lbs. per cu. in.).

29. Insulators, pins and conductor attachments shall be designed to withstand, with the designated factor of safety, the tension in the conductors under the maximum loading, assuming the conductor to be broken on one side of the structure.

30. The pole, or towers, shall be designed to withstand, with the designated factor of safety, the combined stresses from their own weight, the wind pressure on the pole, or tower, and the above wire loading on the crossing span and the next adjoining span on each side. The wind pressure on the poles, or towers, shall be assumed at 13 lbs. per sq. ft. on the projected area of solid or closed structures, and on 1½ times the projected area of latticed structures.

31. The poles, or towers, shall also be designed to withstand the most unfavorable condition of the loads specified in paragraph 30, combined with the unbalanced tension of

Two broken wires for poles, or towers, carrying 5 wires or less.

Three broken wires for poles, or towers, carrying 6 to 10 wires.

Four broken wires for poles, or towers, carrying 11 or more wires.

32. Crossarms shall be designed to withstand the loading specified in paragraph 30, combined with the unbalanced tension of the wire, which, when broken, produces the highest fiber stress in the arm.

33. The poles, or towers, may be permitted a reasonable deflection under the specified loading, provided that such deflection

does not reduce the clearances specified in paragraph No. 10 more than 25 per cent or produce stresses in excess of those specified in paragraphs Nos. 65 to 69.

Factors of Safety.

34. The ultimate unit stress divided by the allowable stress shall be not less than the following:

Wires and cables	2
Pins	2
Insulators, conductor attachments, guys	3
Wooden poles and crossarms	6
Structural steel	3
Reinforced concrete poles and crossarms	4
Foundations	2

NOTE.—The treating of wooden poles and crossarms is recommended. The treatment of wooden poles and crossarms should be by thorough impregnation with preservative by either closed or open-tank process. For poles, except in the case of yellow pine, the treatment need not extend higher than a point 2 ft. above the ground line.

Insulators.

35. Insulators for line voltages of less than 9,000 shall not flash over at four times the normal working voltage, under a precipitation of water of 1/5 of an in. per minute, at an inclination of 45 degrees to the axis of the insulator.

36. Each separate part of a built-up insulator, for line voltages over 9,000, shall be subjected to the dry flash-over test of that part for five consecutive minutes.

37. Each assembled and cemented insulator shall be subjected to its dry flash-over test for five consecutive minutes.

The dry flash-over test shall not be less than:

Line Voltage.	Test Voltage.
Exceeding 9,000, but not exceeding 14,000	65,000
Exceeding 14,000, but not exceeding 27,000	100,000
Exceeding 27,000, but not exceeding 35,000	125,000
Exceeding 35,000, but not exceeding 47,000	150,000
Exceeding 47,000, but not exceeding 60,000	180,000
Exceeding 60,000	3 times line voltage

Each insulator shall further be so designed that, with excessive potential, failure will first occur by flash-over and not by puncture.

38. Each assembled insulator shall be subjected to a wet flash-over test, under a precipitation of water of 1/5 in. per minute, at an inclination of 45 degrees to the axis of the insulator.

The wet flash-over test shall be not less than:

Line Voltage.	Test Voltage.
Exceeding 9,000, but not exceeding 14,000	40,000
Exceeding 14,000, but not exceeding 27,000	60,000
Exceeding 27,000, but not exceeding 35,000	80,000
Exceeding 35,000, but not exceeding 47,000	100,000
Exceeding 47,000, but not exceeding 60,000	120,000
Exceeding 60,000	twice the line voltage

39. Test voltages above 35,000 volts shall be determined by the A. I. E. E. Standard Spark-Gap Method.

40. Test voltages below 35,000 volts shall be determined by transformer ratio.

Material.

Conductors.

41. The conductors shall be of copper, aluminum, or other noncorrodible material, except that in exceptionally long spans, where the required mechanical strength cannot be obtained with the above materials, galvanized or copper-covered steel strand may be used.

42. For voltages not exceeding 750 volts, solid or stranded conductors may be used up to and including 4/0 in size; above 4/0 in size, stranded conductors shall be used. For voltages exceeding 750 volts, and not exceeding 5,000 volts, solid or stranded conductors may be used up to and including 2/0 in size; above 2/0 in size, conductors shall be stranded. For voltages exceeding 5,000 volts, all conductors shall be stranded. Aluminum conductors for all voltages and sizes shall be stranded.

The minimum size of conductors shall be as follows:

No. 6 B. & S. gage copper for voltages not exceeding 5,000 volts.

No. 4 B. & S. gage copper for voltages exceeding 5,000 volts.

No. 1 B. & S. gage aluminum for all voltages.

Insulators.

43. Insulators shall be of porcelain for voltages exceeding 5,000 volts.

44. Strain insulators for guys shall have an ultimate strength of not less than twice that of the guy in which placed. Strain insulators shall be so constructed that the guy wires holding the insulator in position will interlock in case of the failure of the insulator.

Strain insulators for guys shall not flash over at four times the maximum line voltage, under a precipitation of water of 1/5 in. per minute, at an inclination of 45 degrees to the axis of the insulator.

Pins.

45. For voltages of 5,000 and over, insulator pins shall be steel, wrought iron, malleable iron, or other approved metal or alloy, and shall be galvanized, or otherwise protected from corrosion. Pins shall be locked with cotter, nut, or other device, to prevent raising out of the socket or hole in the crossarm.

Guys.

46. Guys shall be galvanized or copper-covered stranded steel cable, not less than 5/16-in. in diameter, or galvanized rolled rods of equivalent tensile strength.

47. Guys to the ground shall connect to a galvanized anchor rod, extending at least one foot above the ground level.

48. The detail of the anchorage shall be definitely shown upon the plans.

Wooden Poles.

49. Wooden poles shall be of selected timber of approved species, peeled, free from defects which would decrease their strength or durability, not less than 7 in. minimum diameter at the top, and meeting the requirements as specified in paragraphs 17, 30, 31 and 34.

Concrete.

50. All concrete and concrete material shall be in accordance with the requirements of the Report of the Joint Committee on Concrete and Reinforced Concrete.

Structural Steel.

51. Structural steel shall be open-hearth, in accordance with the Manufacturers' Standard Specifications.

52. The design and workmanship shall be strictly in accordance with first-class practice.

53. The form of the frame shall be such that the stresses may be computed with reasonable accuracy, or the strength shall be determined by actual test.

54. The sections used shall permit inspection, cleaning and painting, and shall be free from pockets in which water or dirt can collect.

55. The length of a main compression member shall not exceed 150 times its least radius of gyration. The length of a secondary compression member shall not exceed 180 times its least radius of gyration.

56. The minimum thickness of metal in galvanized structures shall be ¼-in. for main members, and ⅛-in. for secondary members. The minimum thickness of painted material shall be ¼-in.

Protective Coatings.

57. All structural steel shall be thoroughly cleaned at the shop and be galvanized, or given one coat of approved paint.

Painted Material.

58. All contact surfaces shall be given one coat of paint before assembling.

All painted structural steel shall be given two field coats of an approved paint.

The surface of the metal shall be thoroughly cleaned of all dirt, grease, scale, etc., before painting, and no painting shall be done in freezing or rainy weather.

Galvanized Material.

59. Galvanized material shall be in accordance with the Specifications for Galvanizing Iron and Steel (Appendix).

Bolt holes in galvanized material shall be made before galvanizing.

Foundations.

60. The foundations for steel poles and towers shall be designed to prevent overturning.

The weight of concrete shall be assumed as 140 lbs. per cu. ft. In good ground, the weight of "earth" shall be assumed at 100 lbs. per cu. ft. In swampy ground, special measures shall be taken to prevent uplift or depression.

61. The top of the concrete foundation, or casing, shall be not less than 12 in. above the surface of the ground or extreme high water.

62. When located in swampy ground, wooden crossing and next adjoining poles shall be set in barrels of broken stone or gravel, or in broken stone or timber footings.

63. When located in the sides of banks, or when subject to washouts, foundations shall be given additional depth, or be protected by cribbing or riprap.

64. All foundations and pole settings shall be tamped in 6-in. layers, while back filling.

Working Unit Stresses.

Obtained by dividing the ultimate breaking strength by the factors of safety given in paragraph 34.

Structural Steel.

	Lbs. per sq. in.
65. Tension (net section)	18,000
Shear	14,000
Compression	$18{,}000 - 60\frac{l}{r}$

Rivets, Pins.

66.	Shear	10,000
	Bearing	20,000
	Bending	20,000

Bolts.

67.	Shear	8,500
	Bearing	17,000
	Bending	17,000

Wires and Cables.

		Lbs. per sq. in.
68.	Copper, hard-drawn, solid, B. & S. gage, 4/0, 3/0, 2/0	25,000
	Copper, hard-drawn, solid, B. & S. gage, 1/0	27,500
	Copper, hard-drawn, solid, B. & S. gage, No. 1	28,500
	Copper, hard-drawn, solid, B. & S. gage, No. 2, 4, 6	30,000
	Copper, soft-drawn, solid, B. & S.	17,000
	Copper, hard-drawn, stranded, B. & S.	30,000
	Copper, soft-drawn, stranded, B. & S.	17,000
	Aluminum, hard-drawn, stranded, B. & S. gage under 4/0	12,000
	Aluminum, hard-drawn, stranded, B. & S. gage 4/0 and over	11,500

Untreated Timber.

		Bending.	Compression.
69.	Eastern white cedar	600 lbs. per sq. in.	600 (1—L/60D)
	Chestnut	850 lbs. per sq. in.	850 "
	Washington cedar	850 lbs. per sq. in.	850 "
	Idaho cedar	850 lbs. per sq. in.	850 "
	Port Orford cedar	1,150 lbs. per sq. in.	1,150 "
	Long-leaf yellow pine	1,100 lbs. per sq. in.	1,100 "
	Short-leaf yellow pine	950 lbs. per sq. in.	950 "
	Douglas fir	1,000 lbs. per sq. in.	1,000 "
	White oak	950 lbs. per sq. in.	950 "
	Red cedar	700 lbs. per sq. in.	700 "
	Bald cypress (heartw'd)	800 lbs. per sq. in.	800 "
	Redwood	850 lbs. per sq. in.	850 "
	Catalpa	500 lbs. per sq. in.	500 "
	Juniper	550 lbs. per sq. in.	550 "

L = Length in inches.
D = Least side, or diameter, in inches.

SPECIFICATION FOR GALVANIZING FOR IRON OR STEEL.

These specifications give in detail the test to be applied to galvanized material. All specimens shall be capable of withstanding these tests.

Coating.

(A) The galvanizing shall consist of a continuous coating of pure zinc of uniform thickness, and so applied that it adheres firmly to the surface of the iron or steel. The finished product shall be smooth.

Cleaning.

(B) The samples shall be cleaned before testing, first with carbona, benzine or turpentine and cotton waste (not with a brush), and then thoroughly rinsed in clean water and wiped dry with clean cotton waste.

The sample shall be clean and dry before each immersion in the solution.

Solution.

(C) The standard solution of copper sulphate shall consist of commercial copper sulphate crystals dissolved in cold water, about in the proportion of 36 parts, by weight, of crystals to 100 parts, by weight, of water. The solution shall be neutralized by the addition of an excess of chemically pure cupric oxide (Cu O). The presence of an excess of cupric oxide will be shown by the sediment of this reagent at the bottom of the containing vessel.

The neutralized solution shall be filtered before using by passing through filter paper. The filtered solution shall have a specific gravity of 1.186 at 65 degrees Fahrenheit (reading the scale at the level of the solution) at the beginning of each test. In case the filtered solution is high in specific gravity, clean water shall be added to reduce the specific gravity at 1.186 at 65 degrees Fahrenheit. In case the filtered solution is low in specific gravity, filtered solution of a higher specific gravity shall be added to make the specific gravity 1.186 at 65 degrees Fahrenheit.

As soon as the stronger solution is taken from the vessel containing the unfiltered neutralized stock solution, additional crystals and water must be added to the stock solution. An excess of cupric oxide shall always be kept in the unfiltered stock solution.

Quantity of Solution.

(D) Wire samples shall be tested in a glass jar of at least 2 in. inside diameter. The jar without the wire samples shall be filled with standard solution to a depth of at least 4 in. Hardware samples shall be tested in a glass or earthenware jar containing at least ½ pint of standard solution for each hardware sample.

Solution shall not be used for more than one series of four immersions.

Samples.

(E) Not more than seven wires shall be simultaneously immersed, and not more than one sample of galvanized material other than wire shall be immersed in the specified quantity of solution.

The samples shall not be grouped or twisted together, but shall be well separated so as to permit the action of the solution to be uniform upon all immersed portions of the samples.

Test.

(F) Clean and dry samples shall be immersed in the required quantity of standard solution in accordance with the following cycle of immersions.

The temperature of the solution shall be maintained between 62 degrees and 68 degrees Fahrenheit at all times during the following test:

(1) Immerse for one minute, wash and wipe dry.
(2) Immerse for one minute, wash and wipe dry.
(3) Immerse for one minute, wash and wipe dry.
(4) Immerse for one minute, wash and wipe dry.

After each immersion the samples shall be immediately washed in clean water having a temperature between 62 degrees and 68 degrees Fahrenheit, and wiped dry with cotton waste.

In the case of No. 14 galvanized iron or steel wire, the time of the fourth immersion shall be reduced to ½ minute.

Rejection.

(G) If after the test described in section (F) there should be a bright metallic copper deposit upon the samples, the lot represented by the sample shall be rejected.

Copper deposits on zinc or within 1 in. of the cut end shall not be considered causes for rejection.

In the case of a failure of only one wire in a group of seven wires immersed together, or if there is a reasonable doubt as to the copper deposit, two check tests shall be made on these seven wires and the lot reported in accordance with the majority of the sets of tests.

NOTE.—The equipment necessary for the tests herein outlined in as follows:

Filter paper.
Commercial copper sulphate crystals.
Chemically pure cupric oxide (Cu O).
Running water.
Warm water or ice, as per needs.
Carbona, benzine or turpentine.
Glass jars at least 2 in. inside diameter by at least 4½ in. high.
Glass or earthenware jars for hardware samples.
Vessel for washing samples.
Tray for holding jars of stock solution.
Jars, bottles and porcelain basket for stock solution.
Cotton waste.
Hydrometer cylinder 3 in. diameter by 15 in. high.
Thermometer with large Fahrenheit scale correct at 62 and 68 degrees.
Hydrometer correct at 1.186 at 65 degrees Fahrenheit.

APPENDIX B.

Paragraphs in Specifications for Overhead Crossing of Electric Light and Power Lines as Adopted by Other Associations Referred to in Report of Committee on Electricity.

10. The clearance of alternating-current circuits above any existing wires, under the most unfavorable condition of temperature and loading, shall be not less than 8 ft. wherever possible. For constant potential, direct-current circuits, not exceeding 750 volts, the minimum clearance above telegraph, telephone and similar wires may be 2 ft. with insulated wires and 4 ft. with bare wires.

13. The clearance in any direction between the conductors nearest the pole, or tower, and the pole, or tower, shall be not less than:

Line Voltage.	Clearances.
Not exceeding 14,000 volts	9 in.
Exceeding 14,000, but not exceeding 27,000	15 in.
Exceeding 27,000, but not exceeding 35,000	18 in.
Exceeding 35,000, but not exceeding 47,000	21 in.
Exceeding 47,000, but not exceeding 70,000	24 in.

18. Strain insulators shall be used in guys from wooden poles carrying any power wire of less than 6,600 volts. Strain insulators shall not be used in guying steel structures, nor required on wooden poles carrying wires all of which are 6,600 volts or more.

Inspection.

24. If required by contract, all material and workmanship shall be subject to the inspection of the company crossed; provided that reasonable notice of the intention to make shop inspection shall be given by such company. Defective material shall be rejected, and shall be removed and replaced with suitable material.

29. Insulators, pins and conductor attachments shall be designed

to withstand, with the designated factor of safety, the tension in the conductors under the maximum loading.

31. The poles, or towers, shall also be designed to withstand the loads specified in paragraph No. 30, combined with the unbalanced tension of:

Two broken wires for poles, or towers, carrying 5 wires or less.

Three broken wires for poles, or towers, carrying 6 to 10 wires.

Four broken wires for poles, or towers, carrying 11 or more wires.

32. Crossarms shall be designed to withstand the loading specified in paragraph No. 30, combined with the unbalanced tension of one wire broken at the pin farthest from the pole.

34. The ultimate unit stress divided by the allowable unit stress shall be not less than the following:

Wires and cables	2
Pins	2
Insulator, conductor attachments, guys	3
Wooden poles and crossarms	6
Structural steel	3
Reinforced concrete poles and crossarms	4
Foundations	2

Note:—The use of treated wooden poles and crossarms is recommended. The treatment of wooden poles and crossarms should be by thorough impregnation with preservative by either closed or open-tank process. For poles, except in the case of yellow pine, the treatment need not extend higher than a point 2 ft. above the ground line.

Pins.

45. For voltages of 5,000 and over, insulator pins shall be of steel, wrought iron, malleable iron, or other approved metal or alloy, and shall be galvanized, or otherwise protected from corrosion.

Wooden Poles.

49. Wooden poles shall be of selected timber, peeled, free from defects which would decrease their strength or durability, not less than 7 in. minimum diameter at the top, and meeting the requirements as specified in paragraphs 17, 30, 31 and 34.

51. Structural steel shall be in accordance with the Manufacturers' Standard Specifications.

55. The length of a main compression member shall not exceed 180 times its least radius of gyration. The length of a secondary compression member shall not exceed 220 times its least radius of gyration.

60. The foundations for steel poles and towers shall be designed to prevent overturning.

The weight of concrete shall be assumed as 140 lbs. per cu. ft. In good ground, the weight of "earth" (calculated at 30 degrees from the vertical) shall be assumed as 100 lbs. per cu. ft. In swampy ground, special measures shall be taken to prevent uplift or depression.

61. The top of the concrete foundation, or casing, shall be not less than 6 in. above the surface of the ground, nor less than 1 ft. above extreme high water.

Discussion.

George W. Kittredge.—There are a number of Associations interested in the specifications for overhead crossings, and we have been trying to get a report which shall be satisfactory to all concerned. Recently, a Joint Committee of the National Electric Light Association, the American Institute of Electrical Engineers, the American Electric Railway Association, and the Association of Railway Telegraph Superintendents made a report, corresponding very closely with this one. In fact many of the differences are simply in words. It seems a very great advantage to have a report acceptable to all these associations. The Joint Committee takes the stand that if we do not accept their specifications, that it will render their work of little value, and think this Association will be in a much better position to accept them.

J. H. Cloberg.—When establishing standards of the B. & O. we found the clearances recommended by this Committee would put part of our equipment out of business.

L. C. Fritch.—The B. & O. was represented on this Committee; this report is to be adopted by the American Railway Association if adopted by us.

Paragraphs 1-8 inclusive were passed without further discussion.

G. A. Mountain.—In paragraph (9) I note the report does not mention trolley lines.

George W. Kittredge.—The Committee has no recommendation on that point. Paragraph 10, we should amend to read "possible," instead of "practicable." I move the change be made for the reasons given above, and, that the paragraph be accepted.

This motion was carried.

H. J. Pfeifer.—The maximum voltage specified in (11) is 70,000. The Terminal R. R. now has an application for one of 100,000 volts.

J. R. W. Ambrose.—We have several line crossings carrying 110,000 volts.

George W. Kittredge.—This subject has not been discussed, and calls for the further consideration of the Committee. This varies from the report of the Joint Committee, and I move that we accept their clause.

Motion carried.

George W. Kittredge.—Paragraph 18 differs from the report of Joint Committee. This paragraph is important and we have held out for its adoption unchanged. We have reason to believe this change will be conceded us, if we concede the others. I move we adopt (18) as written.

Motion carried.

George W. Kittredge.—Our paragraph 24 differs from that of the Joint Committee. I move the adoption of their paragraph 24.

Motion carried.

A. F. Robinson.—It seems to me that the loads specified in (27) are not large enough. Ice forms an oblong, not a circular coat. I think it would be much better if we could arrive at a load per lineal foot, this load to be large enough so we would not have to take ice and snow into consideration.

George W. Kittredge.—Paragraph (29) being different from that proposed by the Joint Committee, I move we adopt their paragraph (29).

Motion carried.

George W. Kittredge.—I move we adopt paragraph (31) of the Joint Committee specifications, as it differs from ours, the difference being slight.

E. B. Katte.—I do not believe in a standard unless it is a good one. This Committee has had these specifications under advisement longer than the Joint Committee. It is quite probable that the Joint Committee will make changes in their next report, so that their specifications will conform to the specifications as prepared by this Committee. So I think we should adopt the specifications as presented and be six months ahead of them. Instead, if they make these changes, and we adopt their present report, they will be six months ahead of us.

R. D. Coombs.—In order to get agreement I think we should adopt their report. The changes are so slight that I don't think any construction will be impaired.

E. B. Katte.—The Association has already adopted (18) which disagrees with their report. Why not now accept the other paragraphs which disagree with them?

L. C. Fritch.—If we follow that course now the chances are the other associations will never agree with us and we will have to take what we can get on crossings.

Paragraph (31) was adopted as given in the report of the Joint Committee.

The rest of the specifications were adopted without discussion.

On motion of Mr. Kittredge paragraphs of the Joint Committee were accepted in place of paragraphs 32, 34, 45, 49, 51, 55, 60, and 61.

Sections A, B, C, D, E, F, G on Galvanizing were adopted as recommended.

Conservation of Natural Resources.

E. O. Faulkner, Chairman; William McNab, Vice-Chairman; R. H. Aishton, Moses Burpee, F. F. Busteed, C. H. Fisk, W. A. McGonagle, G. A. Mountain, W. L. Park, G. H. Webb.

The Board of Direction assigned the following subjects:

(1) Continue the study of tree-planting and general reforestation.

(2) Continue the study of coal and fuel oil resources.

(3) Continue the study of iron and steel resources.

The Committee held a number of meetings during the year, and its researches have been along the general lines suggested by the Board of Direction.

In presenting the report, which is naturally one of progress, the Committee realizes that there is a great difference between the practical application of "Conservation of Natural Resources" to the every-day business conditions met with by the members of the Association and the purely sentimental ideals which may be indulged in by the world in general.

It is felt also that while the Committee was originally formed to co-operate with the National Conservation Commission of this country, as well as with the Commission of Conservation of Canada, yet its principal object was to keep under special observation those particular features in which the railways were directly and practically interested.

It is hoped that the information which the Committee has been able thus far to collect, may, in the method and form in which it is here given, be easy of reference as well as productive of practical benefit to our members, and through them to the railways in general.

Tree Planting and General Reforestation in the U. S.

As leading up to the necessity for tree planting and reforestation, it would seem desirable to consider, first, the extent and location of existing forests, their annual increment, and the yearly consumption of forest products.

These questions were very fully reported upon by the National Conservation Commission. The Commission was assisted in its

labors by experts whose papers form the basis of the report. These papers, representing as they do the original work of experts, form a body of evidence along the various lines pertaining to the timber resources of the country, which will be found valuable for reference.

For the purpose of facilitating a thorough examination of any of the subjects treated in the following report, references are given to these papers as well as to other sources of information, easily obtainable, and which present the matter in sufficient detail to enable a careful study of the various problems to be made.

It was the feeling of the Committee that owing to the magnitude of the questions involved the best results would be obtained by a general review of the subject supplemented by a list of references to authoritative literature. The list of references, while small, is believed to cover the ground sufficiently for the purpose.*

The original forests of the United States (note A) exceeded in the quantity and variety of their timber the forests of any other region of similar size on the globe. Five great forest types were distinguished—the northern, southern, central, Rocky Mountain and Pacific Coast. The kinds of timber and extent of these forests are presented in Table 1.

TABLE 1.
ORIGINAL FORESTS OF THE UNITED STATES.

Forest.	Kinds of Timber.	Quantity Billion F. B. M.	Extent Million Acres.
Northern.....	Cone-bearing trees predominated, with some hardwoods..	1,000	150
Southern.....	Coniferous forest with yellow pine predominating. Interspersed with the pine were a variety of hardwoods.....	1,000	220
Central.....	This is the only forest region in the United States in which the hardwoods predominated.	1,400	280
Rocky Mountain.....	Almost entirely coniferous.....	400	110
Pacific.....	Almost entirely coniferous.....	1,400	90
Total.....	.....	5,200	850

*A very complete Bibliography bearing upon the subject-matter of this report is to be found in Fernow's excellent book, "Economics of Forestry," B. E. Fernow, New York, pp. 491-507.

In addition to these timbered areas there were probably 100,000,000 acres of scrubly forest and brush land, chiefly in the West, which has been and still is a source of much post and fuel material.

The Bureau of Corporations (note B) estimates that there is a total of about 2,800 billion board feet of standing timber in the country. Of this about 2,200 billion feet is privately owned, about 539 billion feet is in the National forests, and about 90 billion feet is on the unreserved public lands, national parks, state lands, and Indian reservations.

The results of the Bureau's investigation of the amount of standing timber in the United States may be summarized as shown in Table 2.

TABLE 2.
STANDING TIMBER IN THE UNITED STATES.

		Billion Feet.
Privately owned timber in investigation area:		
Pacific Northwest	1,013	
Southern Pine Region	634	
Lake States	100	
	1,747	
Outside of investigation area	450	
		2,197
Total owned by Federal Government in National forests		539
Total otherwise owned by Federal Government, owned by states and on Indian reservations		90
Grand Total		2,826

The earliest attack was upon the white pine of the Northeast, the original stand of which is almost entirely cut out. From Table 2 it is apparent that at the present time the two great sources of timber supply, so far as privately owned timber is concerned, are the Pacific Northwest, with 1,013 billion ft. and the Southern pine region, with 634 billion ft. Moreover, 82 per cent of the standing timber owned by the United States Government is in the Pacific Northwest, and nearly all of the remainder is in the other states of the Rocky Mountain region.

The yearly growth of wood (note C) in our forests does not average more than 12 cu. ft. per acre. This gives a total yearly growth of less than seven billion cubic feet.

That our forests grow very slowly, although the individual trees of many kinds grow fast, is our fault. There are about 200 million acres of mature forest mainly in the northern Rockies and on the Pacific Coast in which the yearly growth is balanced by decay.

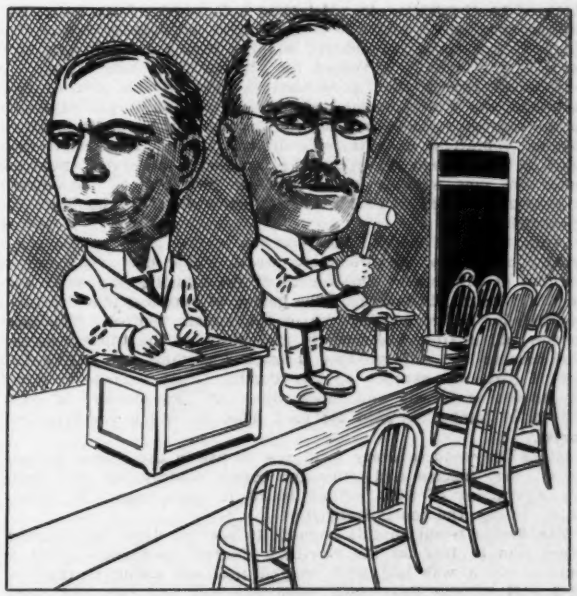
There are 250 million acres, mostly in the Southern mountains and Southern pine belt, partly cut or burned over, but restocking naturally with young growth and 100 million acres chiefly in the Lake States and Southern pine belt which have been cut or burned over upon which young growth is wholly lacking or too scanty to make merchantable timber.

There is taken from the forest (note D) annually, not including loss from fire, 23 billion cubic feet of wood or over three times its yearly growth. This large consumption amounts to 230 cubic feet per capita, while Germany uses 37 cubic feet and France 27 to 25 cubic feet.

Each year there is used 90,000,000 cords of fire wood, 40,000,000,000 board feet of lumber, more than 1,000,000,000 posts, poles and fence rails, 118,000,000 hewn ties, 1,500,000,000 staves, over 133,000,000 sets of heading, nearly 500,000,000 barrel hoops, 3,000,000 cords of native pulp wood, 165,000,000 cubic feet of round mine timbers, and 1,250,000 cords of wood for distillation.

The condition of the world supply of timber makes us already dependent upon what we produce. There is exported out of the country one and one-half times as much timber as is brought in, and except for finishing woods, relatively insignificant in quantity, we must rely upon our own resources for the future supply.

The Forest Service estimates the yearly drain on the saw timber of the country at about 50 billion board ft. Without allowing either for new growth or for any increase in the rate of consumption the total for all the timber in the United States (see Table 2) would represent about 55 years' supply, and that for privately owned timber alone only 44 years' supply.



The Morning After the Banquet.

These conditions affect the railroads of the country not only as they are concerned in the production of timber for their own use, but from the broader viewpoint of developing the territory traversed by their lines. The destruction of the timber is followed by a rapid decline of the industries utilizing the products of the forest with a corresponding loss of revenue for the roads serving the region.

Turning our attention to the conservation of the forest it will be seen, (1) that by the introduction of proper forestry methods the annual productivity of the forest can be considerably increased (Note E) and, (2) that the yearly loss from avoidable causes is much greater than it should be (note F).

There are 225 million acres of producing forest in the country. On this area the stand is so open that all the trees could be grown on 145 million acres, which would be producing at the rate of 70 cu. ft. per acre annually. By growing only the best species this growth can be increased to 80 cu. ft., an increase of 1,450 million cu. ft.

There is an unutilized area of 80 million acres within our present producing forest. There are 135 million acres of absolute

forest land within our virgin or mature forests now unproductive. There are 90 million acres of waste lands which can be made productive by planting, or by fire protection all of these areas can be made to produce 80 cubic feet per acre, or a total of 24,400 million cu. ft.

The total increase possible in the productiveness of our forests is, therefore, 25,850 million cu. ft.

Only 25 per cent of the yield of our present producing forest is saw timber. It can be made from 50 per cent to 75 per cent saw timber through the concentration of growth on the best trees by thinning and the holding of the crop until it reaches good size. This would mean an increase, if all our forest land were productive, from 27,000 million board ft. to between 54,000 million and 81,000 million board ft. per annum.

The enormous loss from fire in our forests every year is a matter of common knowledge. The value of standing timber destroyed each season from this cause has varied from $25,000,000 to more than $100,000,000, the direct annual loss in recent years averaging considerable over $50,000,000. The destruction of young growth, though never included in estimates of fire damage is a principal item of loss. The natural restocking of burned-over lands takes place very slowly or not at all.

All experiences go to prove that damage by forest fires is practically preventable. This stage of development has already been reached in Europe. For example, of 7 million acres in Prussia, an average of only 1,400 acres of one-fiftieth of 1 per cent was burned over each year during the period from 1868 to 1895.

Your Committee feels that the railroads by working with the State Forestry officials can accomplish a great deal of good in the way of prevention of fires started by sparks from locomotives. The Committee is assembling information from both the railroad companies and the State Forest officials in regard to the laws governing the subject and the means used in different parts of the country to reduce the fire risk from this cause.

It would appear that a concerted action on the part of the railroads and State officials is desirable as the forest adjacent to the railroad right-of-way is often left in such a condition after logging operations that it is a difficult matter to prevent fire starting, even when the greatest precaution is observed. Several roads are now working with the State Foresters to accomplish this result; notably the Chicago & Northwestern in the State of Wisconsin.

While the chief loss in timber is due to fire, other causes contribute largely to the prodigious waste which has accompanied our use of the forest. One-fourth of the standing timber is left or otherwise lost in logging. The boxing of long leaf pine for turpentine has destroyed one-fifth of the forests worked. The loss in the mill is from one-third to two-thirds of the timber sawed. The loss in the mill product through seasoning and fitting for use is from one-seventh to one-fourth. Great damage is done by insects to forests and forest products. An average of only 320 ft. of lumber is used for each 1,000 ft. which stood in the forest.

Of all the wood in every form now in use in the United States, decay, fire, insects and saltwater borers destroy not less than the equivalent of 8,000 million board ft. each year. Of these, decay is far the most destructive.

The first attempt in this country to prevent decay by treating wood was in 1838 on the Northern Central Railroad. About a mile of track was laid with treated ties, but owing to the low first cost of the ties which were chestnut and oak and were delivered to the railroad at fourteen or sixteen cents apiece, this did not develop into a permanent industry.

In 1880 for the first time the United States census undertook to ascertain what remained of our timber resources; it was found that they had been very rapidly depleted. Realizing the importance of the question the American Society of Civil Engineers appointed a committee to report upon the best methods of preserving wood, in order to lengthen its life. This committee was appointed in 1880 and after five years of work presented its report in 1885. This was followed by the movement which has culminated in the present large wood preservation industry of the country.

In the year 1910, 97,500,000 cu. ft. of timber was treated. Most of this material consisted of cross-ties. Sixty-three million cu. ft., which constituted about 65 per cent of the total, were treated with the creosote treatment and the remaider with zinc chloride and zinc creosote treatment in the order named.

In the United States the science of forestry is still in the formation stage. Knowledge of the characteristics and requirements of the many species of trees composing the forests is limited; the total amount and distribution of forest wealth is not accurately known; and methods of administration are not yet settled, but are subject to frequent change. In Europe, on the contrary, forestry as practiced today is the result of centuries of gradual evolution, and is consequently thoroughly systematized, and its methods firmly established (note G). Foreign silvicultural methods are not usually applicable without change, but the general systems have been adapted with success to conditions in this country, and should be still more widely used.

A striking point concerning forestry abroad is the important part taken by the State in the management of communal and private as well as of the State forests, and the considerably greater returns obtained under State management. All communal forests are subject to some form of State supervision, and many of them are managed precisely as if they were State property.

Private forests necessary for the protection of water sheds or the welfare of the general public are also subject to State control; they cannot be cleared, cutting must be done as prescribed by the State, and all cuttings must be reforested. Other private forests not necessary for protective purposes can usually be managed as the owner desires, but co-operation with the State in the management of such forests is common.

With a few exceptions comparatively little attention has been paid by the railroads to forestry. Three plantations (note H) have been started in a number of cases, some of which have been on a large scale, but for the most part experimentally. Forest planting in some cases may be desirable when a railroad has waste land for which it has no particular use. It is a good object lesson to the farmers, and if the plantations are successful they will net a fair return on the investment and furnish a limited supply of ties and timber for the future.

It should be observed, however, that it would not be practicable for the individual roads to plant enough trees to supply their timber requirements, and further the critical period of scarcity and high prices would come before any of the trees so planted would reach maturity.

The information assembled by the Committee on Ties of this Association in 1910 shows what has been done by the railroads in the way of tree planting; the situation is very little changed at the present time and in the opinion of those best able to judge, relief from this source is very uncertain.

If the railroads wish to provide against future scarcity and excessive prices with any degree of certainty it will be necessary for them to actively engage in forestry operations having for their purpose the management of mature timber lands and the cultivation and reforestation of the cut-over lands within the forest area. This is an individual problem with every road, but generally speaking, it is the only sound policy which will provide for the future requirements fifteen or twenty years hence.

Some of the railroads have now undertaken to preserve the timber lands which they acquired through land grants and otherwise. The Southern Pacific in Northern California and Southern Oregon still have quite large areas of good timber from which they can cut mature trees. The Northern Pacific has been co-operating with the Government for some years with a view to finding how best to handle their western holdings and provide a source of tie supply at the eastern end of their lines. In the East, the Delaware & Hudson have put about one hundred thousand acres in the Adirondacks under management.

Recommendation for Next Year's Work.

(a) Investigation of the forest fire laws of the different States as they apply to railroads.

(b) The best methods to be used by railroads to reduce risk from fires caused by locomotives.

Coal and Fuel Oil Resources.

The Sub-Committee dealing with the above subject has read and examined a large mass of papers and various data, and it is believed that the following report will prove of value to the Association.

This subject has not heretofore been covered by the Association. The article relating to relative tests of oil as compared to coal is valuable and probably new to 80 per cent of the members. The standard specifications proposed by Mr. McAuliffe are worthy of endorsement by the Association; the Government specifications are also valuable information.

The statistics given in the report are accurate and valuable information.

The essence of the report on this subject is that portion relating to "Methods of preventing or lessening waste in the petroleum industry." This paper is by Mr. David T. Day, of the United States Geological Survey, and is worthy of a great deal of earnest consideration.

(The papers mentioned will appear in a later issue.)

SIGNS, FENCES AND CROSSINGS.

C. H. Stein, Chairman; A. M. Funk, Vice-Chairman; H. E. Billman, G. E. Boyd, L. C. Lawton, E. R. Lewis, J. B. Myers, F. M. Patterson, C. H. Splitstone, W. D. Williams.

The following subjects were assigned by the Board of Direction:

(1) Continue the investigation of ways and means for securing a proper quality of fence wire to resist corrosion and secure durability.

(2) Report on the relative advantages and disadvantages of the different kinds of fence posts.

(3) Report on the best form of track construction and flangeways at street crossings in paved streets.

(4) Report on the relative advantages and disadvantages of the different kinds of telegraph poles.

The committee decided to devote its attention to the first three subjects assigned by the Board of Direction, and also to investigate the general subject of miscellaneous signs for railroad purposes. A series of questions were prepared for submission to the various railways with a view to determining the practice in vogue at this time and to secure the benefit of data that had been accumulated from experiments made in recent years with various forms of fencing wires, and by various processes, as well as with various kinds of wooden and concrete fence posts. Replies were received from 44 railways of the United States and Canada, representing 61,000 miles of track, which developed the following information:

(1) 28 roads are using woven wire exclusively;
6 roads are using barb wire exclusively;
2 roads are using ribbon wire exclusively;
5 roads are using both barb and woven wire.

Woven wire 49 in. to 55 in. in height appears to be generally used. Specifications in use refer merely to method, form of erection, and style of fence, and give practically no consideration to quality of wire or process of manufacture. The wire companies seem to control this latter feature exclusively. In a couple of cases compliance with the specifications of the American Railway Engineering Association is recommended but not explicitly demanded. Only two of the roads are making any experiments in the development of the subject. Experiments in one case, started April 1, 1909, are being conducted with wires grouped in four classes, as follows:

(a) Galvanized after weaving;
(b) Ordinary dip process;
(c) Special galvanized;
(d) Sherardized.

When examination was last made, less than a year ago, (a), galvanized after weaving, was found to be in perfect condition; (b), ordinary dip process, began to corrode during the first year. The corrosion was not so rapid during the second year, but was sufficiently progressive to indicate that deterioration would soon become serious, and the wire go to pieces at points where stay wires were woven around the longitudinal ones; (c), special galvanized, was found to be in excellent condition. No corrosion was apparent, and the wires were still bright. This process is still in an experimental stage, and investigation will be continued. (d), Sherardized. This is a process in which the wire is placed in air-tight receptacles and zinc flue dust packed about it. The receptacles are then heated for a given period of time at a temperature somewhat below the melting point of zinc, the zinc forming a coating over the wires. At the time the test was commenced, this process was not yet far advanced, and later developments may give some promise of success. The results in this case, however, were not good.

Similar tests were commenced under the auspices of the American Society for Testing Materials on the grounds of the Carnegie Technical School, Pittsburg, Pa., on September 26, 1908. The results of these tests will be watched with interest and profit. Several rolling mills are now rolling what is claimed to be a pure metal, running about 99.95 per cent pure iron, and exceedingly low in sulphur, carbon and phosphorus. This is being used for a variety of purposes, and we understand that it can be drawn into wire. This may develop into a proper material for wire making purposes with efficient rust resisting properties.

Copper clad wire is also a form of material that is attracting considerable attention. This consists of a steel core surrounded by a copper jacket applied by mechanical means. The American Consul at Birmingham recently called the attention of the State Department of this Government to the announcement in a British Journal of a new rust-proofing process for iron and steel that is said to be cheap and efficient.

The article to be protected is boiled in a solution whose proportions are: Water, one gallon; phosphoric acid, four ounces, and one ounce of iron filings. This produces a black non-corroding coating that is durable. These different products and methods will be further investigated during the coming year.

It might be stated that English roads use a much heavier wire than those in this country, usually No. 4 to No. 6 gage. All of it is unwiped, and it is said they use a better grade of spelter than we do.

At the present time, undoubtedly the wire galvanized after weaving has proved most durable and efficient, but only certain forms of weaving appear at this writing to be adapted to that process. Progress is being made, however, and if tests now being conducted demonstrate that this is the only manner in which desired results may be obtained, the larger wire mills will discover a means of accomplishing it if the railway companies insist upon it.

(2) Report on the relative advantages and disadvantages of the different kinds of fence posts.

Nine roads which replied to circular are beginning to use concrete posts, and we know of others using them, which gave us no information. Experiments have been conducted for too short a period, however, to enable them to make a definite statement as to their durability, economy and efficiency.

The tendency toward the use of concrete posts, however, is becoming very pronounced, and we should in the course of the next year or so be able to secure some very valuable and satisfactory information. The prices for concrete posts appear to vary between 18 and 40 cents, but the figure largely prevailing for the most popular form of post now on the market is 18 to 22 cents. Since the cost of the various kinds of wood posts now in use ranges from 12 cents to 40 cents, the prevailing cost being 12 to 15 cents, the difference is not so great as to act as a prohibition to the use of concrete. The woods used are necessarily those native to the road and consist of Oregon fir; red, white and Michigan cedar; black, yellow and honey locust; catalpa; tamarack; mulberry; juniper; bois d'arc, chestnut; white and pin oak.

Several forms of metal posts are now being manufactured, and it is claimed by a large manufacturer that they will have a life of at least thirty years and can be delivered at reasonable distances at a price of 23 cents f. o. b. line of road. These will also receive our attention during the current year, in connection with the further investigation of concrete posts.

(3) Report on the best form of track construction and flangeways at street crossings in paved streets.

The customary practice is the very old one of turning an old light rail on its side and backing it up with wood plank, planking solid with wood or planking next to rail and paving with blocks or brick between. The rail or plank forms the flangeway. Five roads of the forty-four referred to use some special form of rail or flangeway through paved streets. In several of the cases a 141-lb. girder rail is employed with suitable compromise bars at each end to connect to the tee-rail sections. In three cases a special form of rolled filler or flangeway, similar to angle bar construction, with extension beyond the rail head similar to street car flangeways, is being considered and gives promise of successful application. Correspondence is now in progress with the steel company to roll a trial order, and it is hoped the experiment may be made during the course of this year, which would perhaps enable us to make a definite recommendation at the next convention.

(4) Report on the relative advantages and disadvantages of the different kinds of telegraph poles.

This subject was not investigated, as very few experiments have thus far been conducted with this form of construction. The industry is growing, however, and attention will be given it this year.

Signs for Railroad Purposes.

There is a growing demand for uniformity of signs for all railroad purposes. It is obvious that it would be a desirable end to be obtained if all signs for use in giving information to the public or employes were of a similar design in all parts of the country. The committee has been investigating the subject with the purpose of producing uniformity, and securing substantial and economic signs, but has not progressed to the point where a conclusion can be reached. It will recommend the subject for definite recommendations at the next convention.

Much information has been received in regard to the foregoing subjects, but it has not been in a sufficiently substantial form, nor in the nature of such new information, that would warrant the committee in making any recommendations in the shape of conclusions. The various subjects, however, are in a progressive stage, and with the mass of information now at hand it appears that the committee will be enabled at the next convention to put the matters in definite shape.

We have been handicapped very much in failing to secure information from our letters of inquiry. Many roads from whom we expected to get beneficial data have failed entirely to reply to our circulars for information. It is possible that this is due to the fact that there are so many committees of the Association reporting on so many different subjects that it is practically impossible for the engineering officers to compile the necessary information and satisfy all of the inquiries. The solution of this problem would, therefore, be that fewer subjects should be assigned for investigation and thus relieve the roads of the great amount of labor that is now necessary in securing and compiling the data on the multitude of subjects on which information has been sought during past years.

The matter of a proper quality of fencing wire to resist corrosion and secure durability has been under consideration by the American Society for Testing Materials, and we would, therefore, make the following recommendations:

(1) That the Board of Directors instruct our committee to endeavor to co-operate with a similar committee of the American

Society for Testing Materials in reaching a conclusion on this latter subject.

(2) That subjects Nos. 2, 3 and 4, assigned last year, be reassigned for study and a report made when the committee considers that it has sufficient data to warrant conclusions.

(3) That the Board of Direction assign the subject of "Uniform Railway Signs for all purposes as applicable to the Public and to Railway Operation."

This report was offered as information and was not discussed.

BUILDINGS.

Maurice Coburn, Chairman; M. A. Long, Vice-Chairman; P. W. Andrews, W. P. Arn, J. P. Canty, O. P. Chamberlain, D. R. Collin, C. P. Delo, W. T. Dorrance, C. H. Fake, A. T. Hawk, N. H. LaFountain, E. N. Layfield, H. A. Lloyd, John S. Metcalf, J. W. Orrock, W. F. Schultz, W. S. Thompson.

The following subjects were assigned by the Board of Direction:

(1) Report on the advantages and disadvantages of various types of freight houses floor construction.

(2) Continue the study of roof coverings.

(3) Present principles covering the design of inbound and outbound freight houses.

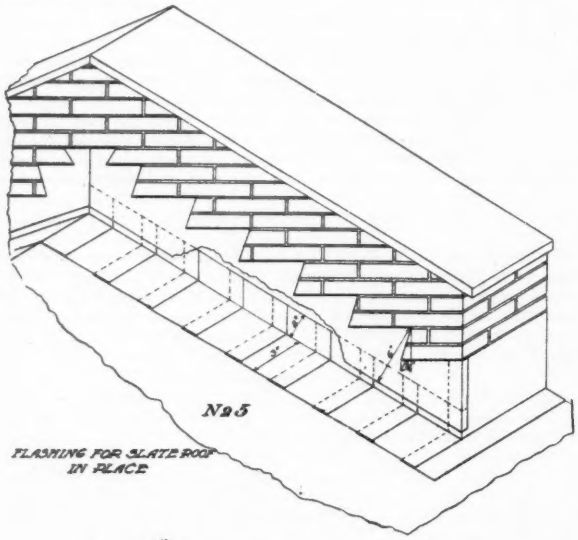
(4) Continue the study of concrete coaling stations.

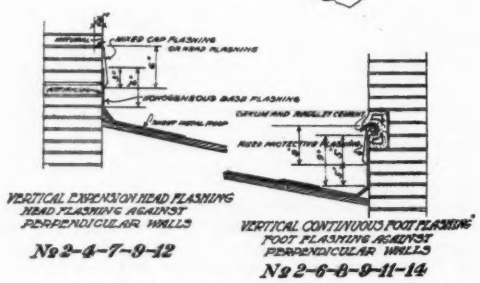
The committee reports progress on subject (1) Report on the advantages and disadvantages of various types of freight house floor construction.

No recommendations are made as to revision of the Manual.

Roof Covering.

The committee presents as information some miscellaneous corrections and additions to last year's report on roofing. As yet the report is incomplete.





DETAILS OF FLASHING AND COUNTER FLASHING FOR ROOFS AND WALLS.

The committee had hoped this year to present specifications for coal-tar pitch, but we were unable to offer sufficient inducements to extract the necessary information.

Page numbers refer to the annual report in Vol. 12, Part 1.

Page 589, last paragraph: A single asphalt fluxed by a single oil is ordinarily an imperfect and unsatisfactory roofing material. Like a cut back tar pitch, it lacks stability. The oil is liable to separate out, sometimes supposedly by capillary attraction into the felt, leaving a brittle compound. The successful asphaltic roofing compounds are ordinarily composed of several different materials.

Page 590, last paragraph: Elaterite occurs in Utah in territory near where gilsonite is found, and has much the same appearance, but is found only in narrow veins. Its qualities are considerably different from those of gilsonite, said to be in part due to the presence of considerable sulphur. From it is made a high-priced product which is supposed to be especially valuable as a constituent of the protective coating of ready roofs. We are of the opinion that some products advertising elaterite contain it in only small quantities, if at all.

Page 591, paragraph 2: Rock Asphalt or Mastic Rock.—There is also bitumen saturated limestone of which that found in Uvalde County, Texas, is an example.

Page 591, last paragraph: The first two sentences should be changed to read as follows: "Eastern oils are largely made up of compounds of the paraffine series, which vary in consistency from comparatively thin oil to hard scale paraffine."

There are other members of the paraffine series which are light gases.

Page 592, paargraph 1: The method of distillation of California oils profoundly modifies the character of the residual.

Page 592, paragraph 2: The blown oils are coming to be more appreciated. They can be made into a very uniform product of great value for many purposes, and now that certain patents covering them are expired, their use will probably broaden considerably.

Page 592, paragraph 4: The bitumen in the coal-tar includes, besides the hydrocarbons, other organic compounds, which are, however, present in roofing pitch only in small quantities.

Page 593, last paragraph: Water Gas Tars.—In making carburetted water gas, the procedure is as follows: Steam is blown through a bed of incandescent coal or coke, where it is broken up, forming blue water gas, which consists of about equal quantities of hydrogen and carbon monoxide. This gas, which has no illuminating value, is passed into a second chamber, which is filled with checker brick and which has been previously raised to a high temperature. Into this chamber is sprayed petroleum oil, which, by the intense heat, is broken down into permanent gas and a tar consisting in the main, of aromatic hydrocarbons similar to those occurring in coal-tar. This permanent gas is of high illuminating value and imparts its luminosity to the blue water gas, while the tars drop out further on in the process of manufacture. It is from this tar that water gas tar pitch and other products are obtained.

Water gas tar contains some free carbon, but usually not over 2 per cent. Its pitch is not acted upon by water. There is a very general opinion among practical roofing men that the water gas tar products are less stable than the coal tar pitches, but we cannot find that there has been any accurate proof of this. Its small percentage of free carbon materially interferes with its value as a roofing pitch. It is said that carbon can be added, but we doubt the commercial practicability of such a scheme.

Page 596, paragraph 6: Burlap decays much more readily than the average cotton felt.

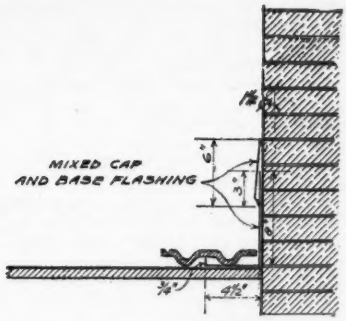
Page 597, last paragraph: To combat severe conditions encountered like those at locomotive engine houses, instead of the dry sheet, an asphalt or oil-saturated felt is sometimes used. This does not so readily deteriorate. One roofer uses for this purpose asphalt asbestos sheets, which are perhaps better yet.

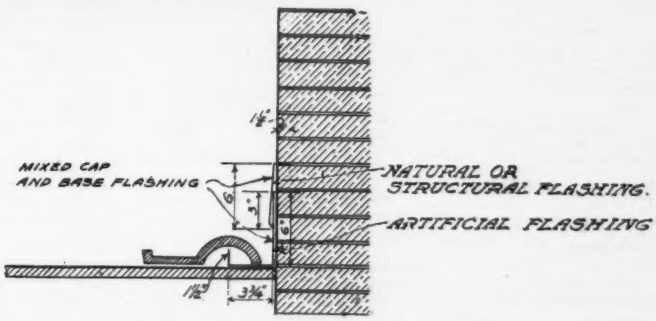
Page 600, last paragraph: General specifications for an asphalt built-up roof cannot well be prepared because of the differences in materials, and ordinarily must come from the manufacturers of the materials.

The successful laying of an asphalt built-up roof in cold weather is a difficult matter. If the asphalt is hot enough to be properly handled, there is chance of charring the felts. On steep slopes thorough mopping is difficult and there is chance of danger to the men. One of the chief reasons for deterioration of the asphalt is supposed to be gradual absorption, due to capillary action of the flux into the felt.

Page 601, second paragraph: Asbestos Asphalt Built-Up Roofings.—It is claimed that asbestos felt, acting as it does more as a protection to the layers of waterproofing material and not merely as a medium for carrying them, does not have any capillary action on the oil fluxes, and that the bitumen is so protected that it retains its elasticity and water-proofing qualities much longer than with the other types of felt. If this point is sustained, asbestos felts have a superiority for asphalt roofing over the ordinary felts which may more than overbalance the increased costs. While the experience obtained from this material is not nearly as extended as that which has been had from rag felts, these roofings have been in use for about eleven years, and we have so far found nothing to disprove this claim.

The asbestos felt has advantage due to its freedom from action by fire and decay, and it is claimed that the asbestos roofings have a considerable value in their blanketing influence on fires inside the building covered, which the ordinary felts do not have, points the value of which we consider have been overemphasized.



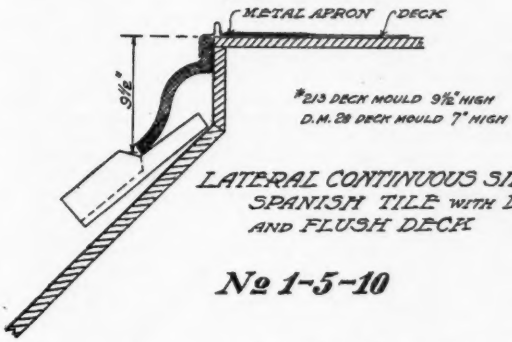


VERTICAL EXPANSION SIDE FLASHING

FLASHING AGAINST PERPENDICULAR WALLS FOR INTERLOCKING TILES

FLASHING AGAINST PERPENDICULAR WALLS FOR SPANISH TILE

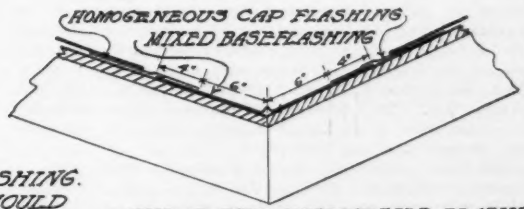
№ 2-7-9



LATERAL CONTINUOUS SIDE FLASHING.
SPANISH TILE WITH DECK MOULD AND FLUSH DECK

№ 1-5-10

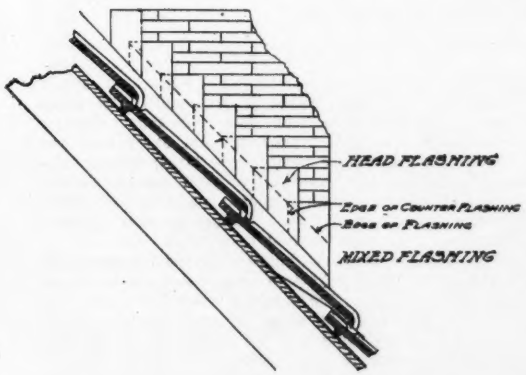
№ 2-7-9



LATERAL EXPANSION SIDE FLASHING
SHOWING VALLEY METAL MINIMUM WIDTH.
WIDTH OF METAL VARIES WITH LENGTH OF VALLEY AND DISCHARGE OF WATER

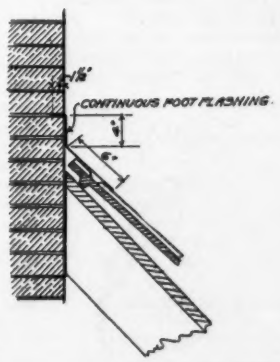
№ 1-3-10

DETAILS OF FLASHING AND COUNTER FLASHING FOR ROOFS AND WALLS.



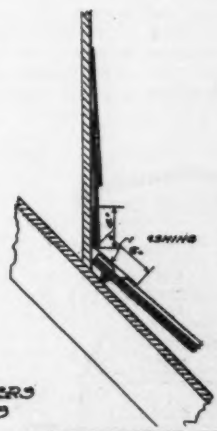
FLASHING AGAINST PERPENDICULAR WALLS FOR INTERLOCKING AND SPANISH TILES

№ 4



FLASHING AT BASE OF DORMERS AND AGAINST BRICK WALLS

№ 2-10

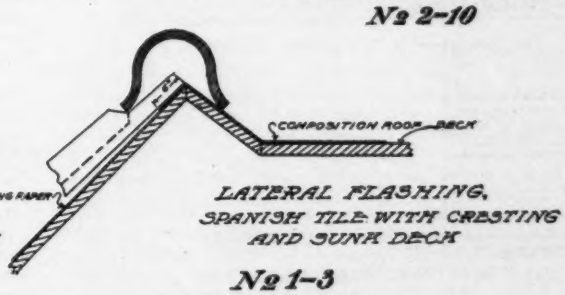


CONTINUOUS FLASHING.
FLASHING AT BASE OF DORMERS IN CONNECTION WITH SIDING TILE

№ 2-10

LATERAL FLASHING
INTERLOCKING TILE
WITH CRESTING AND SUNK DECK

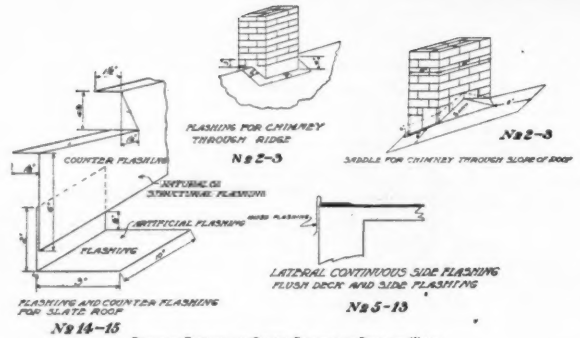
№ 1-3



LATERAL FLASHING.
SPANISH TILE WITH CRESTING AND SUNK DECK

№ 1-3

DETAILS OF FLASHING AND COUNTER FLASHING FOR ROOFS AND WALLS.



Details of Flashing and Counter Flashing for Roofs and Walls.

The asbestos felt is not in any danger of being charred by hot asphalt which sometimes happens with rag felts.

The asbestos built-up roofings also avoid the gravel or slag necessary with the ordinary "wool" felt built-up roofing. This freedom from the use of gravel or slag with its tendency to roll or be washed off the roof into the gutters would seem to be of some advantage. This also makes it easier to locate a leak and leaves the asbestos roofings much lighter in weight than the other types, an advantage which is probably to some extent offset by the insulating power of the much greater amounts of material used with the "wool" felt. As with all built-up asphalt roofings, difficulties encountered in the mopping make a slope of not more than three inches to the foot desirable.

Tar has not been successfully used with asbestos felts.

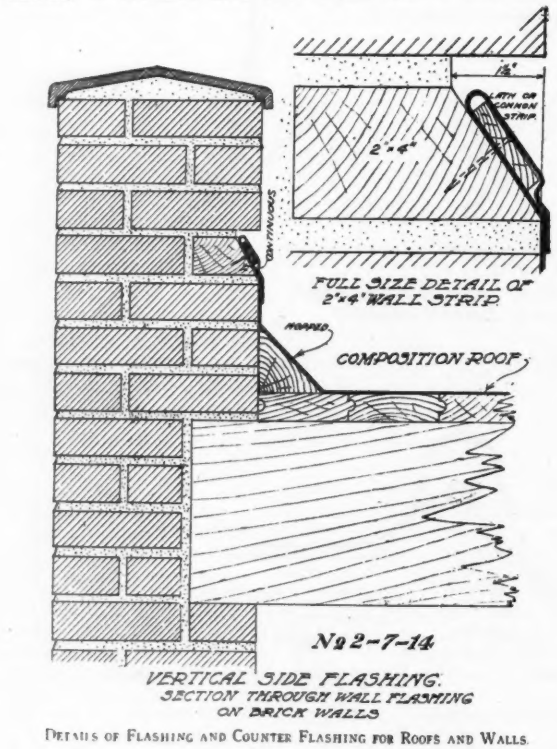
As compared with a five-ply tar and gravel roof a four-ply asbestos roof will ordinarily cost at least from one to two dollars more a square. A three-ply roof is supposed to give good results over concrete, but for wood sheathing it would seem to be approaching too closely to the conditions met with in ready roofing, for first-class work.

Page 609, paragraph 2: Concrete Roofings.—The Asbestos-Portland cement shingles seem to be gaining ground. The different manufacturers use different methods and the results obtained must be used with caution, as it is claimed that the methods of manufacture have an important bearing on the results which may be expected. Shingles of this type are said to have been successfully used abroad for many years. Recent changes are said to have much improved the quality of the material.

For small buildings, or where the design is such as to make tile undesirable, they have especial advantages. The growing difficulty of obtaining good slate should tend to increase their sale. Their cost is somewhat greater than good slate, but their uniformity is such that they can more successfully be laid French or diagonal method than can slate. A considerable saving can be made by laying them French method, but we do not consider this good practice especially with large sheets (see diagram). The material is somewhat brittle and with this method considerably greater amounts of breakage are to be expected, especially on the points.

When new, some water may be absorbed, but as they grow older this defect tends to disappear.

The corrugated sheets should have value as a sustitute for corrugated iron sheets. They must be laid with good fastenings and sufficient lap to insure against leakage. They must not be nailed. Some of these materials are strengthened by wire mesh and some with perforated steel sheets grading toward the metal protected by asphalt and asbestos.



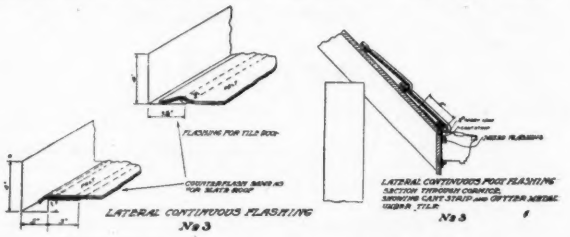
Details of Flashing and Counter Flashing for Roofs and Walls.

Gutters.

Gutters for many classes of railway buildings may and should be omitted. This is more particularly true of buildings with steep roofs near tracks where cinders from passing locomotives roll down the roof into the gutters and in time, unless more care is taken to keep them clean than is usual in railway buildings, the downspouts become choked and fail to carry off the water.

Gutters may be of metal, wood, or be formed in roof of the materials used in the construction of the roof, the latter being ordinarily preferable where the design of the building permits.

Wood gutters are usually of Ogee form on the outside and owing to the thickness of shell the capacity is small for the size of the gutters. They are made in three sizes, 3x4, 4x5 and 4x6. The capacity of these sizes is, however, scarcely more than one-fourth the same size of metal gutters of equal outside dimensions. They are the most durable kind of gutters for buildings exposed to smoke and cinders. They are usually made of fir, white pine or cypress and should be painted inside and out every few years.



Details of Flashing and Counter Flashing for Roofs and Walls.

Metal gutters are made of copper, galvanized steel, iron, tin or zinc. For permanent buildings, copper is preferable. All joints should be soldered and riveted with not less than four rivets for smaller sizes and should be well braced at least every four feet and proportionately increased in number for larger sizes. The common grades of galvanized steel often used cannot be depended on for more than two or three years. Some of the refined irons now on the market should be of value for this purpose. Cast-iron gutters are used to a limited extent.

Gutters may be built in the roof, or hanging, as the design of the building requires. Hanging gutters, which are easier to repair, and which do not damage the building if defective, are generally preferable. They should be given as much slope as practicable to the various downspouts and the outer edge of hanging gutters should be low enough to avoid chance of damage by possible backing up of water due to stopped-up gutters and conductor pipes.

Copper gutters should be given a coat of linseed oil and tin gutters a coat of iron oxide paint soon after hanging, and galvanized iorn should not be painted until about a year of exposure to the weather unless a special acid treatment is applied to provide a surface which will hold the paint. If a galvanized iron roof is used where copper gutters are applied, care should be taken to insulate or separate the two metals so that galvanic action will be prevented.

Flashings.

The following definitions, together with the diagrams, are presented as information concerning flashings. The numbers accompanying the different diagrams refer to the numbers of the definitions.

(1) Flashings are the mechanical unions between roof surfaces and other parts of the structure intersecting and bounding the plane of the roof, and between roofs in different planes.

(2) Vertical Flashings are flashings between roofs and other parts of the structure which intersect the plane of the roof and extend through or above the roof. (Examples: Walls, parapets, combings, soil pipes.)

(3) Lateral Flashings are flashings between roofs and other parts of the structure which bound the roof or which intersect

the plane of the roof without extending above it, or, flashings between roofs in different planes. (Examples: Cornices, eaves, gutters, leader heads, ridges, hips, valleys.)

(4) Head Flashings are flashings which are approximately at right angles to the general slope of the roof, at the top of the incline.

(5) Side Flashings are flashings which are approximately parallel to the general slope of the roof.

(6) Foot Flashings are flashings which are approximately at right angles to the general slope of the roof, at the foot of the incline.

(7) Expansion Flashings are flashings built of two independent parts, each of which is respectively an integral part of the roof, and of the adjoining structure.

(8) Base Flashing is that part of an expansion flashing which is an integral part of the roof.

(9) Cap or Counter Flashing is that part of an expansion flashing which is an integral part of the adjoining structure.

(10) Continuous Flashings are flashings which are integral parts of both roof and adjoining structure, without slip or expansion joint.

(11) Protective Flashing is that part of a continuous flashing which is an integral part of the adjoining structure, but which does not form an expansion joint with a base flashing.

(12) Homogenous Flashings are flashings built of the same materials as the roof.

(13) Mixed Flashings are flashings formed of materials other than materials of the roof. (Examples: A metal base flashing for a felt roof.)

(14) Natural or Structural Flashings are flashings which are formed structurally integral with the roof or adjoining structure. (Example: A cap flashing built into a raglet in a parapet wall.)

(15) Artificial Flashings are flashings which are not structurally integral with either the roof or the adjoining structure. (Example: A "base" or "continuous" flashing supported upon the adjoining structure by adhesion of materials, or outside cleats.)

The accompanying diagrams are designed to be only illustrative of the distinctions defined above. No effort has been made to formulate recommendations for details of applications of different materials under different conditions.

This report was offered as information and there was no discussion.

UNIFORM GENERAL CONTRACT FORMS.

J. C. Irwin, Chairman; W. G. Atwood, Vice-Chairman; E. F. Ackerman, W. L. Breckinridge, R. G. Kenly, E. H. Lee, C. A. Paquette, H. C. Phillips, J. H. Roach, H. A. Woods, C. A. Wilson.

J. C. Irwin, Chairman Uniform General Contract Forms.

The committee has considered and presents herewith, for discussion, the form suggested for Agreement A, and also the following sections for the General Conditions B:

1. Bond.
2. Contractor's Understanding.
3. Intent of Plans and Specifications.
4. Permits.
5. Protection.
6. Rights of Various Interests.
7. Consent to Transfer.
8. Superintendence.
9. Timely Demand for Points and Instructions.
10. Report Errors and Discrepancies.
11. Preservation of Stakes.
12. Inspection.
13. Defective Work or Material.
14. Insurance.
15. Indemnity.
16. Settlement for Wages.
17. Liens.
18. Work Adjacent to Railroad.
19. Risk.
20. Order and Discipline.
21. Contractor Not to Hire Company's Employes.
22. Intoxicating Liquors Prohibited.
23. Cleaning Up.
24. Engineer and Chief Engineer Defined.
25. Power of Engineer.
26. Adjustment of Dispute.
27. Order of Completion. Use of Completed Portions.
28. Changes.
29. Extra Work.
30. Property and Right of Entry.
31. Unavoidable Delays. Extension of Time on Parts of Work.
32. Suspension of Work.
37. Monthly Estimate.

The committee has discussed, but not formally acted upon, the following Sections, 33, 34, 35, 36 and 38.

The committee especially presents for approval:

(1) The general scheme of having the two-page general agreement, Form A, as a folder, within which the other portions of the contract can be bound, thus permitting a concise contract form or a large contract form, according to the requirements of the case.

(2) The Agreement—Form A—as presented herewith.

(3) Sections 1 to 32 and Section 37 of B General Conditions.

For next year's work recommendations are made as follows:

(1) Reconsider standard contract form so far as presented in the light of discussions presented at the convention or by letter.

(2) Complete the construction of final sections of contract.

(3) Consider advisability of having any supplementary standard forms in conjunction with Uniform General Contract Form, and prepare such contract forms as may be considered advisable.

CONSTRUCTION CONTRACT.

A—Agreement.

This Agreement, made this.....day of.....in the year.....by and between..... party of the first part, hereinafter called the Contractor, and .....party of the second part, hereinafter called the Company.

Witnesseth, That, in consideration of the covenants and agreements hereinafter mentioned, to be performed by the parties hereto and of the payments hereinafter agreed to be made, it is mutually agreed as follows:

The Contractor shall furnish all the necessary transportation, materials, superintendence, labor and equipment, and shall execute, construct and finish, in an expeditious, substantial and workmanlike manner, to the satisfaction and acceptance of the Chief Engineer of the Company.

.....
.....

in accordance with the plans hereto attached or as herein described, and the following general conditions, requirements and specifications, forming part of this contract.

The work covered by this contract shall be commenced..... .....and be completed on or before the .....day of....., 191.., ...
.....
.....

And in consideration of the completion of the work described herein, and the fulfillment of all stipulations of this agreement to the satisfaction and acceptance of the Chief Engineer of the Company, the said Company shall pay, or cause to be paid, to said Contractor, the amount due the Contractor, based on the following prices:

.....
.....

This agrement shall inure to the benefit of and be binding upon the legal representative and successors of the parties respectively.

In Witness Whereof, The parties hereto have executed this agreement in.....the day and year first above written.

Witness:

....
....

B—General Conditions.

Bond.

1. The Contractor agrees, at the time of the execution and delivery of this contract and before the taking effect of the same, to furnish and deliver to the Company a good and sufficient bond of indemnity to the amount of.....dollars, as secured for the faithful performance, by the Contractor, of all the covenants and agreements on the part of the Contractor contained in this contract. The security in such bond of indemnity must be satisfactory and acceptable to the Company.

This bond shall remain in force and effect in such amount, not greater than that specified, as shall be determined by the Chief Engineer, until the final completion and acceptance of the work.

Contractor's Understanding.

2. It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this contract. No verbal agreement or conversation with any officer, agent or employe of the Company, either before or after the execution of this contract, shall affect or modify any of the terms or obligations herein contained.

Intent of Plans and Specifications.

3. All work that may be called for in the specifications and not shown on the plans, or shown on the plans and not called for in the specifications, shall be executed and furnished by the Contractor as if described in both these ways; and should any work or material be required which is not denoted in the specifications or plans, either directly or indirectly, but which is nevertheless necessary for the proper carrying out of the obvious intentions thereof, the Contractor is to understand the same to be implied and required, and shall perform all such work and furnish any such material as fully as if they were particularly delineated or described.

Permits.

4. Permits of a temporary nature necessary for the prosecution of the work shall be secured by the Contractor. Permits for permanent structures or permanent changes in existing facilities shall be secured by the Company.

Protection.

5. Whenever the local conditions, laws or ordinances require, the Contractor shall furnish and maintain, at his own cost and expense, necessary passageways, guard fences and lights and such other facilities and means of protection as may be required.

Rights of Various Interests.

6. Wherever work being done by Company forces or by other Contractors is contiguous to work covered by this contract the respective rights of the various interests involved shall be determined by the Engineer, to secure the completion of the various portions of the work in general harmony.

Consent to Transfer.

7. The Contractor shall not let or transfer this contract or any part thereof (except for the delivery of material) without consent of the Chief Engineer, given in writing. Such consent does not release or relieve the Contractor from any or all of his obligations and liabilities under the contract.

Superintendence.

8. The Contractor shall constantly superintend all the work embraced in this contract, in person or by a duly authorized manager acceptable to the Company.

Timely Demand for Points and Instructions.

9. The Contractor shall not proceed until he has made timely demand upon the Engineer for, and has received from him, such points and instructions as may be necessary as the work progresses. The work shall be done in strict conformity with such points and instructions.

Report Errors and Discrepancies.

10. If the Contractor, in the course of the work, finds any discrepancy between the plans and the physical conditions of the locality, or any errors in plans or in the layout as given by said points and instructions, it shall be his duty to immediately inform the Engineer. Any work done after such discovery, until verified, will be done at the Contractor's risk.

Preservation of Stakes.

11. The Contractor must carefully preserve bench marks, reference points and stakes, and in case of wilful or careless destruction, he will be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

Inspection.

12. All work and materials shall be at all times open to the inspection, acceptance or rejection of the Engineer or his duly authorized representative. The Contractor shall at all times provide reasonable and necessary facilities for such inspection.

Defective Work or Material.

13. Any omission or failure on the part of the Engineer to disapprove or reject any work or material shall not be construed to be an acceptance of any defective work or material. The Contractor shall remove, at his own expense, any work or material condemned by the Engineer, and shall rebuild and replace the same without extra charge, and in default thereof the same shall be done by the Company at the Contractor's expense—or, in case the Chief Engineer should not consider the defect of sufficient importance to require the Contractor to rebuild or replace any imperfect work or material, he shall have power, and is hereby authorized, to make any deduction from the stipulated price that he may deem proper.

Insurance.

14. The Contractor shall secure in the name of the Company and for its benefit, policies of fire insurance on such structures and in such amounts as shall be specified by the Chief Engineer not exceeding .....

Indemnity.

15. The Contractor shall indemnify and save harmless the Company for and from all claims, demands, payments, suits, actions, recoveries and judgments of every nature and description brought or recovered against it, by reason of any act or omission of the said Contractor, his agents or employes, in the execution of the work by or in consequence of any negligence or carelessness in guarding the same.

Settlement for Wages.

16. Whenever, in the opinion of the Chief Engineer, it may be necessary for the progress of the work to secure to any of the employes of the Contractor any wages which may then be due them, the Company is hereby authorized to pay said employes the amount due them or any lesser amount, and the amount so paid them, as shown by their receipts, shall be deducted from any moneys that may be or become payable to said Contractor.

Liens.

17. If an established lien be filed against the Contractor for labor or material furnished in the performance of the work, the Company is hereby authorized to pay and discharge the same, if it shall deem best so to do, and to deduct the amount so paid from any moneys which may be or become due and payable to the Contractor.

Work Adjacent to Railroad.

18. Whenever the work embraced in this contract is near the tracks, structures or buildings of this Company or of other railroads, the Contractor shall use proper care and vigilance to avoid injury to persons or property. The work must be so conducted as not to interfere with the movement of trains or other operations of the railroad; or, if in any case such interference be necessary, the Contractor shall not proceed until he has first obtained specific authority and directions therefor from the proper officer of the Company and has the approval of the Engineer.

Risk.

19. The work in every respect shall be at the risk of the Contractor until finished and accepted, except damage or injury caused directly by Company's agents or employes.

Order and Discipline.

20. The Contractor shall at all times enforce strict discipline and good order among his employes, and any employe of the Contractor who shall appear to be incompetent, disorderly or intemperate, or in any other way disqualified for or unfaithful to the work entrusted to him, shall be discharged immediately on the request of the Engineer, and he shall not again be employed on the work without the Engineer's written consent.

Contractor Not to Hire Company's Employes.

21. The Contractor shall not employ or hire any of the Company's employes without the permission of the Engineer.

Intoxicating Liquors Prohibited.

22. The Contractor, in so far as his authority extends, shall not permit the sale, distribution or use of any intoxicating liquors upon or adjacent to the work, or allow any such to be brought upon, to or near the line of railway of the Company.

Cleaning Up.

23. The Contractor shall, as directed by the Engineer, remove from the Company's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste materials resulting from his operations.

Engineer and Chief Engineer Defined.

24. Wherever in this contract the word Engineer is used, it shall be understood as referring to the Chief Engineer of the Company, acting personally or through an assistant duly authorized in writing for such act by the Chief Engineer, and wherever the words Chief Engineer are used it shall be understood as referring to the Chief Engineer in person, and not to any assistant engineer.

Power of Engineer.

25. The Engineer shall have full power to reject or condemn all work or material, which, in his opinion, does not conform to this contract; to direct the application of forces to any portion of the work which, in his judgment, requires it; to order the force increased or diminished, and to decide every question that may arise between the parties relative to the execution of the work.

Adjustment of Dispute.

26. All questions or controversies which may arise between the Contractor and the Company, under or in reference to this contract, shall be subject to the decision of the Chief Engineer, and his decision shall be final and conclusive to both parties.

Order of Completion; Use of Completed Portions.

27. The Contractor shall complete any portion or portions of the work in such order of time as the Engineer may require. The Company shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding the time for completing the entire work or such portions may not have expired; but such taking possession and use shall not be deemed an acceptance of the work so taken or used or any part thereof. If such prior use increases the cost of or delays the work, the Contractor will be entitled to such extra compensation, or extension of time, as the Chief Engineer may determine.

Changes.

28. The Company shall have the right to make any changes that may be hereafter determined upon, in the nature or dimensions of the work, either before or after its commencement, and such changes shall in no way affect or void this contract. If such changes diminish the quantity or extent of the work to be done, they shall not, under any circumstances, be construed as constituting, and shall not constitute a claim for damages or for anticipated profits on such work.

In case quantities in the completed work vary from the quantities shown on the original plans, and provided for in the specifications, then the final payment shall be adjusted on the basis of unit rates specified in this contract.

Note.—First paragraph of Section 28 to be used in unit price and force account contracts, i. e., in all contracts not on lump-sum prices. Should be omitted in lump-sum contracts.

Extra Work.

29. No bill or claim for extra work or material shall be allowed or paid unless the doing of such extra work or the furnishing of such extra material shall have been authorized in writing by the Engineer before any part of such work was done or material furnished.

The price for such work shall be determined by the Chief Engineer, who may either fix a unit price or a lump-sum price, or may, if he so elects, provide that the price shall be determined by the actual cost, to which shall be added.....per cent to cover general expense and superintendence, profits, contingencies, use of tools, Contractor's risk and liability. If the Contractor shall perform any work or furnish any material which is not provided for in this contract, or which was not authorized in writing by the Engineer previous to the doing of the work or the furnishing of material, said Contractor shall receive no compensation for such work or material so furnished, and does hereby release and discharge the Company from any payment therefor.

If the Contractor shall proceed with such extra work or the furnishing of such extra material as hereinbefore provided, then such work or material, stated in the written authority of the Engineer, shall be covered, governed and controlled by all the terms and provisions of this contract, subject to such prices as may be agreed upon or fixed by the Chief Engineer.

If the Contractor shall decline or fail to perform such work or furnish such extra material as authorized by the Engineer in writing, as aforesaid, the Company may then arrange for the performance of the work in any manner it may see fit, the same as if this contract had not been executed, and the Contractor shall not interfere with such performance of the work.

Property and Right of Entry.

30. The Company shall provide the lands upon which the work under this contract is to be done, except that the Contractor shall provide land required for the erection of temporary construction facilities and storage of his material, together with right of access to the same.

The Contractor shall not enter upon said lands, nor ship any material or equipment, until he has received written notice from the Engineer that he may proceed with said work or any part thereof.

Unavoidable Delays; Extension of Time on Parts of Work.

31. If the Contractor shall be delayed in the performance of the work from any cause, for which the Company is responsible, he shall, upon written application to the Chief Engineer at the time of such delay, be granted such extension of time as the Chief Engineer shall deem equitable and just.

Suspension of Work.

32. The Company may at any time stop the work, or any part thereof, by giving ten (10) days' notice to the Contractor in writing. The work shall be resumed by the Contractor in ten (10) days after the date fixed in the written notice from the Company to the Contractor so to do. The Company shall not be held liable for any damages or anticipated profits on account of the work being stopped, or for any work done during the interval of suspension. It will, however, pay the Contractor for expense of men and teams necessarily retained during the interval of suspension, provided the Contractor can show that it was not reasonably practicable to move these men and teams to other points at which they can be engaged. The Company will further pay the Contractor for time necessarily lost during such suspension at the rate of..... per cent per annum on the estimated value of all equipment and fixtures owned by the Contractor and employed on the work which are necessarily idle during such suspension, said rate of..... per cent per annum being understood to include depreciation, interest and insurance. But if the work, or any part thereof, shall be stopped by the notice in writing aforesaid, and if the Company does not give notice in writing to the Contractor to resume work at a date within.....of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work suspended and he will be entitled to the estimates and payments for such work so abandoned, as provided in Sections.....of this contract.

Annulment, Contractor's Fault.

33. Discussed, but not acted upon by the committee.

Annulment, Without Fault of Contractor.

34. Discussed, but not acted upon by the committee.

Removal of Equipment in Case of Annulment.

35. Discussed, but not acted upon by the committee.

Measurement and Approval of Work.

36. Discussed, but not acted upon by the committee.

Monthly Estimate.

37. So long as the work herein contracted for is prosecuted in accordance with the provisions of this contract, and with such progress as may be satisfactory to the Chief Engineer, the said Chief Engineer will on or about the first day of each month make an approximate estimate of the proportionate value of the work done and of material furnished or delivered upon the Company's property at the site of the work, up to and including the last day of the previous month. The amount of said estimate, after deducting.....per cent and all previous payments, shall be due and payable to the Contractor at the office of the Treasurer of the Comapny on or about the 20th day of the current month.

Final Estimate.

38. Discussed, but not acted upon by the Committee.

Discussion.

J. P. Snow.—I do not think it necessary to use the titles "party of the first part" and "party of the second part." I think that the name of the job should appear at the top of the contract, so it will be easy to locate one when looking over a large number.

W. G. Atwood.—The question of the way to designate the contracts is one of personal opinion. The name of the work could be printed across the top of this form, if so desired.

Prof. C. F. Allen.—I think it advisable to get as clear a distinction as possible between the two parties, and I think that the terms "party of the first part" and "party of the second part" do much to give a sharp distinction, especially if the description of one of the parties is somewhat elaborate.

J. P. Snow.—I think the name of the job should be given in the first paragraph and then specify that in the following clauses "the work" will be used to designate the job named. This gives three distinct terms, the "Contractor," the "Work" and the "Company," provided we take out reference to "party of the first part" and "party of the second part."

A. S. Baldwin.—I agree with Mr. Snow. The contract offered is a mixture of two old forms. First and second parties were first used to do away with long names. Brevity is gained by naming the parties direct in every case.

W. G. Atwood.—We find that some of the legal departments require these designations of the parties.

A. S. Baldwin.—I move that "party of the first part" and "party of the second part" be eliminated from the first paragraph.

C. H. Stein.—I think the specifications as prepared should be accepted. It frequently happens that the parties to a contract have somewhat similar names, and by referring back to this first paragraph, we could easily distinguish between the two. I think if this question was submitted to our legal departments, that the form proposed would be acceptable. Before we reject it I think it should be subjected to our legal departments.

Geo. H. Bremner.—It is frequently the case that two or three interests form one or both of the parties, and therefore the form submitted is desirable.

A. S. Baldwin.—In a case of that kind, the parties could be named in the first paragraph and designate that such party be "hreinafter called the Contractor," etc.

The amendment was voted on and lost.

J. B. Berry.—I think that a blank line or two should be left for the description of the parties, as it frequently takes some space to give the names of parties.

E. A. Frink.—I think that the committee has asked for the wrong date. The date given in the contract should be the day it was accepted, not necessarily the day it was signed.

A. R. Raymer.—I think we should change the wording concerning the plans, which reads "attached hereto," and substitute "on plans identified by the signatures of parties hereto." The plans are usually too large to be attached, and think we should have a means of positively identifying them.

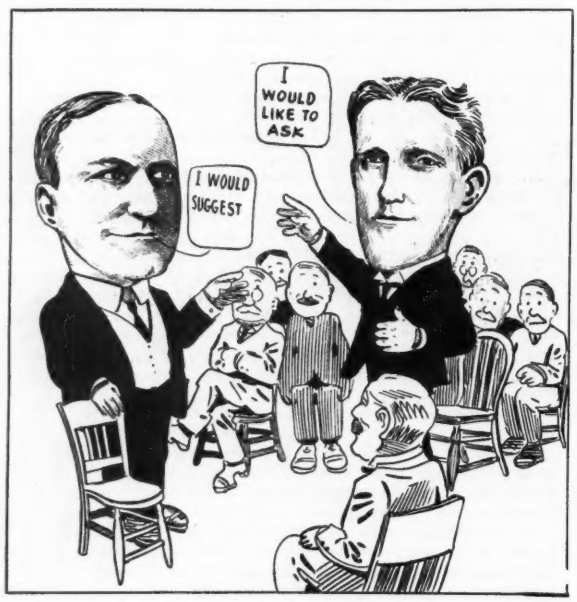
W. G. Atwood.—That point is taken care of by the words "or as herein described."

A. R. Raymer.—In work of any size the plans are frequently changed, so I think the original plans should be identified by the signature of the parties. Therefore, I move the following amendment in place of "hereto attached," we use the words "identified by the signatures of the parties hereto."

This motion was lost.

W. F. Steffens.—Is there a space to be left for description of the plans?

W. G. Atwood.—We did not think that necessary in the general form. We expect the form to be somewhat changed in individual cases, and that could be taken care of in this way.



Willing to Discuss Any Subject.

The form of Contract "A" was put to a vote and carried, and "B," general conditions, was taken up.

C. E. Lindsay.—I think confusion would result from the distinction between permits of a temporary and permanent nature, as these are sometimes hard to classify.

W. G. Atwood.—It is intended that the contractor shall obtain only those permits which are necessary in the construction, while the railway is to obtain all others.

W. F. Steffens.—The last sentence in paragraph (13) gives the chief engineer the sole authority to pass on deductions for work not up to specification or extras. This is pretty dangerous from the contractor's standpoint. I suggest we insert "as agreed on by the parties."

W. G. Atwood.—It is an unusual thing to allow the chief engineer to accept work below specification, but we think he should have this power. It frequently would mean an acceptance of work which will answer the purpose all right, at a reduction from the original price. This would prevent tearing out work which would be satisfactory, and perhaps would greatly delay other construction if not accepted.

A. R. Raymer.—I would suggest that a "no lien" clause be inserted, as this is allowable under the laws of some states.

W. G. Atwood.—We think that cases which occur under various state laws should be treated in special clauses.

W. F. Steffens.—I think an arbitration clause should be inserted between 26 and 27.

W. I. Trench.—I want to offer an amendment which will take care of a condition we met with recently: "The Contractor shall locate his plant only after carefully consulting the plans and the Engineer in charge of the work, so that there will be no interference with Company business while he occupies the premises. Upon the demand of the Engineer, the Contractor must remove such part of his plant as obstructs Company work, but which he was allowed to erect temporarily. If the Contractor fails to remove such portions af his plant, the Company shall remove it at the expense of the Contractor."

This amendment was lost.

J. E. Greiner.—Paragraph 29 is rather hard on the Contractor. He is sometimes forced to go ahead and do extra work in order to keep on with the work, and doesn't have time to wait for the approval of the Chief Engineer. I think that we should allow the Contractor extra pay for work where the approval of the Chief Engineer is secured after the work has been done. In these specifications the "Engineer" would not have the authority to do this even if he wanted to.

J. B. Jenkins.—I think this clause might deter the Contractor from going ahead with necessary work.

L. C. Fritch.—Mr. Greiner's objection would be removed if these words be left out of the clause, "previous to doing the work."

W. G. Atwood.—The committee will accept that.

C. E. Lindsay.—It will be necessary to omit these words also, "after receiving the written authority therefor."

W. G. Atwood.—The committee accepts that.

G. D. Swingly.—I think the words "necessarily detained" are indefinite in paragraph 32.

C. E. Lindsay.—Would it not be better to leave out the words "in sections" near the bottom of paragraph 32?

A. S. Baldwin.—This clause leaves lots of room for dispute with the Contractor as to the value of equipment and number of days idle. We usually specify a price per day for delays, such that the Contractor will be just as anxious to get to work as we are to have him. This prevents the Contractor from killing time on one contract when he has no other in sight.

E. A. Frink.—Referring to section 37, we have found it advisable to have the contract give the unit prices on which monthly estimates are to be based.

J. B. Berry.—I would like to ask if this contract has been submitted to any of our legal departments?

W. G. Atwood.—We did submit this to legal departments of several railways, but their opinions disagree.

J. B. Berry.—The committee members shall take it up with their respective railways.

W. G. Atwood.—This is only a general form and cannot be expected to satisfy the legal departments of all roads. Recently five legal departments gave five different opinions on a single case of this kind.

L. C. Fritch.—I think the committee has done good work. But I agree with Mr. Berry, and I think that this report should be accepted as information and referred back.

W. G. Atwood.—The case where the Contractor becomes insolvent is to be considered in a clause which is not ready for presentation at this time.

The contract form was accepted as information and referred back to the committee.

ECONOMICS OF RAILWAY LOCATION.

A. K. Shurtleff, Chairman; R. N. Begien, Vice-Chairman; C. Frank Allen, Willard Beahan, C. P. Conard, A. C. Dennis, C. P. Howard, W. A. James, Fred Lavis, C. J. Parker, F. W. Smith, Francis Lee Stuart, Walter Loring Webb, M. A. Zook.

Your committee realizes that some of the members of our association may be disappointed in its failure to produce a report having some logical conclusions. The failure to report at the 1911 convention was explained at the time, but during the past year the committee has been greatly encouraged in its work by the receipt of considerable valuable operating information.

Under date of October 26, 1911, the chairman was able to send to such members of the committee as had shown any interest in the work a tabulated statement by accounts of the operating costs of nine large railways, comprising 13 per cent of the main track mileage of the United States, over 18 per cent of the freight train mileage, and over 16 per cent of the passenger train mileage. In some cases the more important accounts covering "Conducting Transportation" were separated between Passenger and Freight Service, which will be of particular value to your committee in the final analysis of the questions to be considered.

In addition to the cost data, information has been tabulated covering the density of traffic per mile of main track in train miles, car miles and ton miles.

The working members of your committee have been devoting such time as they could spare to the study of the statistics tabulated, and to a portion of them it becomes apparent that no fixed values can be established for distance, curvature, rise and fall, or gradient. A careful study of the data covering costs by primary accounts apparently indicates that costs in some of the accounts

vary with the number of train miles and the ratio of freight train mileage to passenger train mileage.

In other cases the logical unit of variation is the ton mile, or car mile depending entirely on the account in question. Further, the density of traffic both as to train mileage and ton mileage enters into the costs.

The result is that your committee has refrained from presenting any conclusions for your consideration until it has had time to thoroughly digest the information now at hand.

A portion of your committee believes that each case must be considered by itself, with a probability that the values used for the unit costs will vary widely, depending on local conditions of traffic with reference to car loading, character and density of traffic, etc., and in some cases on climatic conditions.

Your committee hopes to present a report during the coming year which will show one or more methods of practical analysis of the question covering conditions that exist with each case.

Discussion.

L. C. Fritch.—This committee cannot arrive at results unless given data by members of this association, and I think each member should make an attempt to give it to them.

A. K. Shurtleff.—I will state that the committee has recently received some very valuable information, for which we wish to thank those members who responded.

GRADING OF LUMBER.

Dr. Hermann von Schrenk, Chairman; B. A. Wood, Vice-Chairman; D. Fairchild, R. Koehler, A. J. Neafie, W. H. Norris, F. B. Walker, C. W. Richey.

Your special committee on Grading of Lumber has not held any formal meetings during the year, the discussions having been carried on by correspondence. The committee wishes to re-submit the Definitions of Defects and Lumber Grading Rules submitted in its report last year, with certain slight changes, indicated below. The committee believes that they fairly represent Specifications for Maintenance of Way Lumber as it can be purchased in the market today. The rules submitted may not suit all conditions. It is pointed out, however, that the acceptance of these rules by the association, with a proviso that individual grades can be departed from where the requirements of any particular road seems to make same necessary, will represent a great step forward in bringing about uniform rules for the grading of lumber. It appears to the committee that slight differences of opinion, concerning one or more grades, should not interfere with the acceptance of these rules in a general way.

The rules as submitted last year have been changed so as to bring them into harmony with those already published in the Manual. The Descriptions and Definitions of Defects are in accord with those already adopted by the association as standard. There have been added this year Grading Rules for Cypress Lumber.

Recommendations.

Your committee recommends that the Lumber Grading Rules as presented last year, subject to the corrections and including the additions made below, be adopted as standard.

Following is a list and reference to the Proceedings where the data included in these recommendations can be found:

(1) Classification and Grading Rules for Douglas Fir (pp. 548-555, Vol. 12, Part 3, Proceedings for 1911).

(2) Specifications for Douglas Fir Structural Timbers. (Substitute for paragraphs 38-51, inclusive, pp. 556, 557, Vol. 12, Part 3, Proceedings, the Specifications for Douglas Fir Bridge and Trestle Timbers, as given on pp. 143 and 144, Manual, 1911. For paragraphs 54 and 55, page 557, Vol. 12, Part 3, Proceedings, substitute paragraphs 1, 2, 3, 6 and 7, as given on page 145, Manual, 1911).

(3) Classification, Grading and Dressing Rules for Northern Pine, including White and Norway Pine and Hemlock (pp. 565, 577, Vol. 12, Part 3, Proceedings, 1911).

(4) Classification, Grading and Dressing Rules for Southern Yellow Pine (pp. 578-600, Pol. 12, Part 3, Proceedings, 1911). (For paragraphs 43-59, inclusive, substitute paragraphs 1-14, inclusive, as given on pp. 141 and 142, Manual, 1911.)

(5) Standard Specifications for Construction Oak Timbers (pp. 601-606, Vol. 12, Part 3, Proceedings, 1911).

(6) Classification and Grading Rules for Cypress Lumber and Shingles, presented in this report.

APPENDIX E.

Classification and Grading Rules for Cypress Lumber and Shingles.

General Instructions.

Cypress lumber shall be graded according to the following rules and specifications, bearing in mind that as no arbitrary set of rules and specifications can be maintained in every case, much must be left to the common-sense and best judgment of the inspector:

1. Lumber shall be manufactured and shipped in standard lengths and thicknesses.

2. Tank, 1st and 2d and worked partition shall be graded from the poorer side.

3. Select lumber, flooring, ceiling, bevel siding and finishing shall be graded from the better or finished side, but the reverse side should in no case be more than one grade lower.

4. All lumber shall be tallied surface or face measure, the tally counted up, and the one-quarter or one-half added to the total where the lumber is one and one-quarter or one and one-half inches thick, and 2 in. and thicker to be multiplied by the thickness.

5. In the measurement of all lumber, fractions exactly on the one-half foot are to be given alternately to the buyer and the seller; the fractions below the one-half foot are to be dropped, and all fractions above the one-half foot are to be counted to the next higher figure on the board rule.

6. In "line boards," pieces 14 ft. and longer shall be given the advantage in grade; pieces 12 ft. and shorter shall be reduced in grade.

The "Committee" on Grading of Lumber.

7. Recognized defects in cypress are knots, knot holes, shake, splits, wane, worm holes, stained sap and peck.

Standard Defects.

8. A standard knot is sound and not to exceed 1¼ in. in diameter.

9. A small sound knot is one not exceeding ¾ in. in diameter.

10. Two small knots not to exceed in extent or damage one 1¼ in. knot.

11. One straight split not to exceed in length the width of the piece.

12. Worm, grub, knot and rafting pin holes not exceeding in damage one 1¼ in. knot.

13. Ordinary season checks shall not be considered a defect in any grade.

14. Ordinary season checks are such as occur in lumber properly covered on yard, or season checks of equal size in kiln-dried lumber.

15. Bright sap is not a defect in select or below.

16. Pin worm holes, sound knots and stained sap shall not be considered a defect in No. 1 barn or below.

Standard Lengths.

17. All random standard length stock may be furnished in odd as well as even foot lengths, but there shall not be to exceed 20 per cent of odd lengths in any one item.

18. Tank stock and No. 1 barn shall be 8 ft. and longer.

19. 1st and 2d and select shall be 10 to 20 ft.

20. Finish, flooring, ceiling, partition, bevel and drop siding shall be 10 to 20 ft.

21. Moldings and battens of all sizes 6 to 20 ft., in both odd and even foot lengths, but not exceeding 10 per cent of 6, 7, 8 and 9 ft. lengths.

22. No. 2 barn, 6 ft. and longer.

23. Cull or peck, 4 ft. and longer.

Standard Finished Sizes of Cypress.

24. All lumber shipped in the rough (except 8/4 in. No. 1 and No. 2 "Dimension," which grades may be ¼-in. under or ¼-in. over the size specified, both in thickness and width) shall be of sufficient thickness to S2S to standard thickness, as follows:

25. 4/4 lumber S1S or S2S shall be 13/16-in. thick.

26. 5/4 select, 1st and 2d clear, selected common tank and tank lumber S1S or S2S, shall be 1⅛ in. thick.

27. 5/4 peck, No. 1 and No. 2 barn and finishing lumber S1S or S2S, shall be 1 1/16 in. thick.

28. 6/4 select 1st and 2d clear, selected common tank and tank lumber S1S or S2S, shall be 1⅜ in. thick.

29. 6/4 peck, No. 1 and No. 2 barn and finishing lumber S1S or S2S, shall be 1 5/16 in. thick.

30. 8/4 lumber, except No. 1 and No. 2 barn or dimension S1S or S2S shall be 1¾ in. thick.

31. 8/4 No. 1 and No. 2 barn or dimension S1S or S2S shall be 1⅝ in. thick.

32. 10/4 lumber S1S or S2S shall be 2¼ in. thick.

33. 12/4 lumber S1S or S2S shall be 2¾ in. thick.

34. All lumber S1E takes off ⅜ in. S2E, ½ in.

35. All flooring shall be S2S and C. M.

36. 4/4 flooring shall be 13/16 in. by 2¼ in., 3¼ in., 4¼ in., 5¼ in. face.

37. 5/4 flooring shall be $1\frac{1}{16}$, 6/4 shall be $1\frac{5}{16}$, by same widths as 4/4.

38. ⅜ ceiling shall be worked $\frac{5}{16}$ in., S1S only.

39. ½ ceiling shall be worked $\frac{7}{8}$ in., S1S only.

40. ⅝ ceiling shall be worked $\frac{9}{16}$ in., S1S only.

41. ¾ ceiling shall be worked $\frac{11}{16}$ in., S1S only.

42. All widths of ceiling to be the same as flooring, unless otherwise specified. Ceiling up to 3¼ in. face to have one bead on one edge and ceiling wider than 3¼ in. face to be beaded center and edge.

43. Partition to be finished the same as ceiling, but on both faces.

44. Drop siding shall be worked ¾ in. by 3¼ in., 4¼ in., 5¼ in., 7¼ in., 9¼ in. face, S2S and C. M. or shiplapped.

45. Bevel siding or bevel cribbing shall be worked ½ in. less in width than the rough strip measure.

Tank Stock.

46. This grade shall be random widths, and will not be furnished in specified widths, and shall be graded from the poorer side.

47. This grade shall be 5 in. and wider, 1½ in. to 4 in. thick and 8 ft. and over in length. Pieces up to 7 in. shall be free from sap. Pieces 7 in. to 13 in. may have 1 in. of sound sap on one edge, not to exceed half the length and half the thickness of the piece. Pieces 14 in. and wider may have 1 in. of sound sap on both edges not to exceed half the length and half the thickness of the piece. In all widths sound knots that do not impair usefulness for tank purposes may be admitted.

First and Second Clear.

48. This grade shall be random widths, and will not be furnished in specified widths, and shall be graded from the poorer side.

49. This grade shall be 8 in. and wider, 1 in. to 4 in. thick and 10 ft. and over in length. Pieces 8 in. to 10 in. may have 1 in. of bright sap on each edge, or its equivalent on one or both edges, otherwise they must be clear. Pieces 10 in. and under 12 in. may have 1½ in. of bright sap on each edge or 3 in. on one edge, and may have one standard knot or its equivalent. Pieces 12 in. wide may have 2 in. of bright sap on each edge ,or 4 in. on one edge, and may have one standard knot; or, in lieu of sap, may have two standard knots or their equivalent. Pieces wider than 12 in. may admit of defects as specified above in proportion as width increases. Pieces 10 in. and wider may admit of one end split, which shall not exceed in length the width of the piece. Pieces 12 in. and less in width, free from other defects, may have bright sap across one face at one end, but this sap shall not exceed in length one-tenth of the length of the piece. In pieces 13 in. and wider bright sap is not a defect.

Selects.

50. This grade shall be random widths, and will not be furnished in specified widths, and shall be graded from the better side, but the reverse side shall not be of a lower grade than No. 1 shop or No. 1 barn.

51. This grade shall be 7 in. and wider, but will not be furnished wider than 12 in.; shall be 1 in. to 4 in. thick, 10 ft. and longer. Pieces 10 in. and under in width shall admit two standard knots or their equivalent and an additional standard knot or its equivalent for every 2 in. in width over 10 in. Pieces free from other defects, 10 in. and over in width, to admit pin worm holes on one edge one-tenth the width of the piece. Bright sap is not a defect in this grade. Slight wane on pieces 10 in. and over in width is allowed on one edge not over 3 ft. in length. When no other defect appears, slight amount of stained sap may be allowed. Pieces 10 in. and wider may admit of one end split, which shall not exceed in length the width of the piece.

Selected Common Tank Stock.

52. This grade shall be 4 in. wide, or wider, 1½ in. and 2 in. thick, 8 ft. and over in length. Sound sap no defect in this grade, but must be free from unsound knots or other defects that extend through the thickness of the piece, and must be square edged to work the full length of the piece.

No. 1 Barn or Dimension.

53. This grade shall be specified widths only, shall be 3 in. and wider, 1 in. and thicker, 8 ft. and over in length, admitting sap, bright or stained, shake, season checks, knots, pin worm holes, a small amount of peck on one side and one edge, or very slight peck on both sides and both edges of pieces comparatively free from coarse defects; which defects, however, shall not be sufficient to seriously impair the strength, or prevent the use of each piece for "common" purposes in its full length and full width.

No. 2 Barn or Dimension.

54. This grade shall be specified widths, 3 in. and wider, 1 in. and thicker, 6 ft. and over in length, admitting all the defects allowed in No. 1 barn, but same may be larger and coarser, and in addition will admit peck on both sides; however, the defects shall not be sufficient to prevent the use of each piece in full length and full width for low-grade fencing and other very common purposes.

Cull or Peck.

55. This grade may be random or specified widths 3 in. and wider, 1 in. to 4 in. thick, 4 ft. and over in length. Shall admit all pieces below the grade of No. 2 boxing, and shall also admit the product of that part of the log known as "pecky;" however, each piece shall have sufficient strength and nailing surface to permit its use as a low grade boxing, crating, sheeting and foundation material.

Finishing.

56. Shall be specified widths 4 in. and wider, 1 in. to 2 in. thick, 10 ft. and over long, and shall be graded from the better side, A, B and C, but the reverse side should not be more than one grade lower. All grades of finish, rough or S1S or S2S may vary ¼ in. from the width specified.

57. "A" Finish.—Pieces 4 in. and 5 in. wide shall be clear of sap, knots and other defects. Pieces 6 in. wide may have 1 in. of bright sap, or in lieu of sap one small sound knot. Pieces 7 in. and 8 in. wide may have 2 in. of bright sap, or in lieu of sap one small sound knot. Pieces 9 in. and 10 in. wide may have 3 in. of bright sap, or in lieu of sap two small sound knots, or 1½ in. of bright sap and one small sound knot. Pieces 12 in. wide may have 4 in. of bright sap, or in lieu of sap one standard knot, or two small sound knots, or 2 in. of bright sap and one small sound knot. Pieces 14 in. or wider may have more defects in proportion as the width increases.

58. "B" Finish.—Pieces 4 in., 5 in. and 6 in. wide may have 2 in. of bright sap and one or two small sound knots, or in lieu of knots may have all bright sap. Pieces 7 in. and 8 in. wide may have 3 in. of bright sap and two small sound knots, or in lieu of knots may have all bright sap. Pieces 9 in. and 10 in. wide may have 4 in. of bright sap and one standard knot or three small sound knots, or in lieu of knots may have all bright sap. Pieces 12 in. wide may have 6 in. of bright sap and one standard or four small sound knots, or in lieu of knots may have all bright sap. This grade will not be furnished wider than 12 in.

59. "C" Finish.—All widths in this grade shall admit small sound knots, stained sap, pin worms and other defects except shake; but none that will prevent the use of same in its full width and length as a paint grade, and will admit pieces containing one coarse defect which can be removed by making two cuts with a waste of not to exceed 5 per cent in the one piece removed, but which pieces are otherwise "B" grade or better. This grade will not be furnished wider than 12 in.

60. "D" Finish.—All widths will admit sound knots, stained sap, pin worms, slight shakes, and other defects; but none that will prevent the use of same in its full width and length as a common paint grade. This grade will not be furnished wider than 12 in.

Siding.

61. Siding shall be 4 in. and 6 in. in width, 10 ft. to 20 ft. in length, and graded from the finished side, A, B, C and D.

62. "A" Siding.—May have 1 in. of bright sap on thin edge, and may contain one small sound knot.

63. "B" Siding.—May have any amount of bright sap, or if not all bright sap, may have three small sound knots, shake, split or pin worm holes not exceeding in damage the three small knots as above, and may have slight wane on the thin edge. In the absence of other defects a small amount of stained sap will be permitted.

64. "C" Siding.—May have one to five knots, the whole not aggregating over 3 in. in diameter, or knots, splits or other defects that can be removed in two cuts with waste not exceeding 10 per cent of the length, or may have small amount of stained sap and pin worm holes not exceeding in damage the five small knots above described.

65. "D" Siding.—May have stained sap and pin worm holes, or may have other defects that will not cause a waste to exceed one-third the piece.

Flooring and Ceiling.

66. Shall be specified widths, 10 ft. to 20 ft. in length and graded from the finished side, or if both sides are finished, it shall be graded from the better side, A, B, C and D.

67. "A"—May have bright sap on one edge one-fourth its width, otherwise must be clear.

68. "B"—May have one-half of its face bright sap if otherwise clear, or in lieu of sap, may contain two small sound knots, or may have a split not to exceed 9 in. at one end.

69. "C" (10 to 20 ft.)—May have all bright sap, or may have one to five knots, the whole not aggregating over 3 in., or knots or other defects that can be removed in two cuts with waste not exceeding 10 per cent of the length, or may have three pin worm holes, or may have check or split at one end, not to exceed 10 per cent of the length.

70. "C" (4 to 9 ft.)—May have all bright sap, small sound knots, stained sap, pin worm holes and other defects except shake, but none that will prevent the use of each piece the full length.

71. "D"—May have stained sap and pin worm holes, or may have unsound knots or other defects that will not cause a waste to exceed one-third the piece.

Partition.

72. Shall be same widths and lengths as flooring and ceiling, but shall be graded from the poorer side, A, B, C and D, same grading to apply as in flooring and ceiling.

Pickets.

73. Shall be graded No. 1 and No. 2.

74. 1 in. by 1 in. shall be Headed and S4S to $\frac{13}{16}$ in. by $\frac{13}{16}$ in.

75. 1¼ in. by 1¼ in. shall be Headed and S4S to $1\frac{1}{16}$ in. by $1\frac{1}{16}$ in.

76. 1½ in. by 1½ in. shall be Headed and S4S to $1\frac{1}{16}$ in. by $1\frac{1}{16}$ in.

77. 1 in. by 3 in. shall be Headed and S4S to ¾ in. by 2½ in.

78. No. 1.—Shall be well manufactured, bright sap, no defect and may contain one small sound knot.

79. No. 2.—Shall admit stained sap, sound knots, pin worm holes, slight shake, and pickets thrown out of the No. 1 grade because of poor manufacture.

Battens.

80. Battens, both flat and O. G., are not moldings. Same are invariably used with "common" lumber and shall, therefore, be graded No. 1 barn and better, admitting all defects allowed in No. 1 barn, but none that will prevent the use of each piece in full length for Batten purposes. ⅜ in. battens shall be 1 in. strips S2S to $\frac{13}{16}$ in. by 2½ in. and resawed, or 1 in. by 2¾ in. to 3 in. S2S and resawed. Unless otherwise specified, ⅜ in. or flat battens shall be S2S only and resawed.

81. O. G. Battens shall be manufactured in the sizes and pattern shown in the Universal Molding Book.

Car Roofing and Siding.

82. "C and Better" Grade.—This grade will admit sound knots, stained sap, pin worm holes, very slight shake and other defects, but none that will prevent the use of each piece in its full width and length for car roofing and car siding; may be random or specified lengths and may be worked to pattern specified and graded from pattern side or S2S and C M and graded from the better side.

Car Lining.

83. Shall be specified widths and 8 to 20 ft. in length. Will admit tight knots, stained sap, pin worm holes, slight shake and other defects, but none that will prevent the use of each piece in its full width and length for car-lining purposes.

Shingles.

84. Bests.—A dimension shingle, 4, 5 and 6 in. in width, 16 in. long, each width packed separately, 5 butts to measure, 2 in., to be all heart and free of shake, knots and other defects.

85. Primes.—A dimension shingle, 4, 5 and 6 in. in width, 16 in. long, each width packed separately, 5 butts to measure 2 in., admitting tight knots and sap, but free of shake and other defects, but with no knots within 8 in. of the butts.

86. This grade may contain shingles clipped two-thirds of the width and one-eighth of the length on the point.

87. Star a Star.—A random width shingle 3 in. and wider, 14 in. to 16 in. long, otherwise the same as primes.

88. Economy.—Dimensions 4, 5 and 6 in., each width separately bunched, admitting sap and sound knots, may have slight peck 5 in. from butts, imperfections on points no objection and admitting 14 in. shingles.

89. Clippers.—All shingles below the above grades which are sound for 5 in. from the butts, worm holes and slight peck excepted, random widths 2½ in. and wider.

90. The count of our manufacture of shingles, of all grades, is based on 4,000 linear inches in width, making 1,000 standard shingles, consequently there would be only 667 6-in. shingles packed and counted as 1,000 standard shingles; 5-in. dimension being counted in like proportion.

91. In making re-inspections of shingles, one bundle out of 20 bundles taken at random, shall be cut open, the results of this investigation to form the basis of arriving at the grade of the entire shipment.

Appendix E was offered as information only. The rest of the report was adopted with very little discussion.

WOOD PRESERVATION.

Earl Stimson, Chairman; E. H. Bowser, Vice-Chairman; G. M. Davidson, H. B. Dick, W. W. Drinker, Dr. W. K. Hatt, V. K. Hendricks, George E. Rex, E. A. Sterling, C. M. Taylor, Dr. H. von Schrenk, Charles Yoder, C. E. Knickerbocker.

The Board of Direction assigned the following subjects:

(1) Continue investigation of the proper grouping of the different timbers for antiseptic treatment.

(2) Compile available information from service tests.

(3) Investigate the merits of various preservatives, giving special attention to oil from gas tar and to the use of refined coal tar in creosote oil.

(4) Report on the advisability of revising the adopted specifications for creosote oil.

(5) Recommend forms for the inspection of preservative processes.

(6) Present specifications for impregnation with creosote oil.

(7) Report on the value of impregnation with crude oil.

(8) Report on the value of brush coating and dipping.

A sub-committee was assigned to the consideration of each one of these subjects.

(1) Grouping of Timbers for Antiseptic Treatment.

The Sub-Committee on Grouping was instructed to continue the investigations of the proper grouping of timbers for antiseptic treatment. Last year arrangements were made for a series of co-operative experiments at several plants to determine the best method of grouping various species in different regions. These tests have not been completed, but some progress has been made, the results of which are submitted as Appendix "A" to this report. During the coming year additional experimental work will be done at several plants. This work will be systematized, so that uniform results will be obtained and as definite a basis as possible established for grouping under representative conditions.

Considerable time must elapse before the experimental work will be brought to a point where final conclusions can be drawn. Past experience, however, has demonstrated certain fundamental facts in relation to grouping, and it is recommended that such principles as have received recognition in standard practice be embodied in the Manual. These fundamentals can be elaborated upon in the future as additional information becomes available.

The principles recommended at the present time for insertion in the Manual are as follows:

(1) Ties of approximately the same period of seasoning should be grouped together for treatment; green ties should never be mixed with seasoned ones.

(2) Pine ties should be separated on the basis of heartwood and sapwood; it would also be advisable in some cases to group hardwoods on the same basis, but it is not generally practical to do so.

(3) Grouping on the basis of species and families, as, for example, red oaks, pines, beeches, etc., if a further division into heartwood classes is made with pine, is usually a satisfactory practice. From this it follows that red oak, beech, long-leaf pine, loblolly pine and gum should be treated separately. Birch and hard maples and certain other combinations, depending on the locality, can be grouped together to advantage.

(4) The separation in the yard, on the basis the ties are to be grouped for treatment, is an essential and economical practice.

(2) Records from Service Tests.

The recommendations of the report of the committee for 1911 included the recommendation that certain sections of track be selected on each railroad for the purpose of making accurate tests covering the life of treated and untreated ties. To ascertain the extent to which this has been done in the past, and the results which have been obtained, the committee sent out a circular letter.

(3) Merits of Various Preservatives.

Your committee was directed to give special attention to the merits of oil from water gas tar and to the use of refined coal tar in creosote oil. Sufficient information has not been obtained to enable report to be made on these subjects at this time. The investigations will be continued the coming year.

(4) Revision of the Adopted Specifications for Creosote Oil.

After careful consideration it seems desirable to change the first clause in the adopted Specifications for Creosote Oil to provide that it shall be a pure product from coal gas tar or coke oven tar and free from any foreign admixture, including coal gas tar or coke oven tar.

With this change, the entire specifications for creosote oil will read as follows:

STANDARD SPECIFICATIONS FOR CREOSOTE OIL.

The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal gas tar or coke oven tar and shall be free from any tar, including coal gas tar, coke oven tar, oil or residue obtained from petroleum, or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least 1.03. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall give no distillate below two hundred (200) degrees centigrade, not more than five (5) per cent below two hundred and ten (210) degrees centigrade, not more than twenty-five (25) per cent below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent in quantity, shall be soft. The oil shall not contain more than three (3) per cent water.

In addition to the above standard specification, the two following grades can be used in cases where the higher grade oil cannot be procured. It should be understood that where it is necessary to purchase grades No. 2 and No. 3 consideration should be given to the use of a greater quantity of creosote oil per cubic foot.

SPECIFICATIONS FOR NO. 2 GRADE CREOSOTE OIL.

The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal gas tar or coke oven tar, and shall be free from any tar, including coal gas tar or coke oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least 1.03. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall give not more than eight (8) per cent distillate below two hundred and ten (210) degrees centigrade, not more than thirty-five (35) per cent below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent in quantity, shall be soft. The oil shall not contain more than three per cent water.

SPECIFICATIONS FOR NO. 3 GRADE CREOSOTE OIL.

The oil shall be the best obtainable grade of coal-tar crosote; that is, shall be a pure product obtained from coal gas tar or coke oven tar and shall be free from any tar, including coal gas tar or coke oven tar; oil, or residue obtained from petroleum or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least 1.025. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall give not more than ten (10) per cent distillate below two hundred and ten (210) degrees centigrade, not more than forty (40) per cent below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent in quantity, shall be soft. The oil shall not contain more than three (3) per cent water.

No change is recommended at this time in the "Specifications for Analysis of Creosote Oil," except that this heading should be changed to read "Specifications for the Fractionation of Creosote Oil." This specification merely covers the fractionation and does not cover the chemical analysis which would be necessary in order to determine the presence of adulteration. The determination in regard to adulterants can be made chemically in several manners with the same results, and there does not, therefore, seem to be the necessity for preparing a complete specification covering chemical analysis that there is for preparing the specification covering the fractionation, the latter giving different results when made by different methods.

For the purpose of obtaining more information in regard to the relative merits of the flask and retort for the fractionation of creosote oil, and also for the purpose of obtaining other information on which to base further consideration of the specification for fractionation, it has been arranged that various samples of creosote oil be submitted to the various railroads for analysis by various methods, the reports obtained being submitted in writing to the Committee as soon as possible for action by the Committee next year.

(5) Forms for Reporting Inspection.

It is found that the various railroad and timber-treating companies have their own forms for the inspection and recording of the various preservative processes, each meeting their own peculiar conditions, although similar in the essential details. Your Committee is not now prepared to submit report on this subject, but will continue its consideration the coming year.

(6) Specification for Impregnation with Creosote Oil.

A specification for impregnation with creosote oil has already been adopted by the Association and is contained in the Manual. It is the sense of your Committee that this specification is in accordance with good practice, and no change is recommended.

(7) Value of Impregnation with Crude Oil.

Your committee is not in position to report at this time and recommends the continuance of the subject for the coming year.

(8) Value of Brush Coating and Dipping.

A circular letter was sent out making inquiry as to these methods of treatment. Out of thirty-eight replies, thirty-one report that neither process has been used, and seven report that no definite conclusions can be drawn from their experience. It is recommended that further consideration be given this subject.

Conclusions.

It is recommended:

(1) That the four principles of Grouping of Timbers, as given under subhead (1), Grouping of Timbers for Antiseptic Treatment, be accepted for insertion in the Manual.

(2) That the revised Standard Specifications for Creosote Oil, and the Specifications for No. 2 Grade and No. 3 Grade Creosote Oil, as given under subhead (4), Revision of Adopted Specifications for Creosote Oil, be adopted.

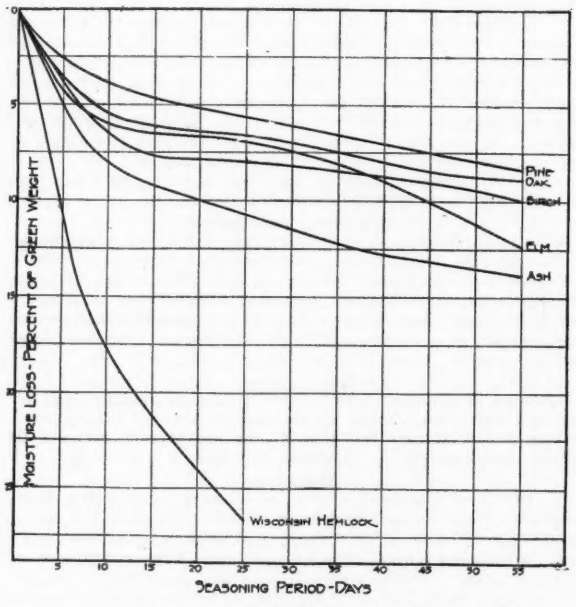
(3) That the heading "Specifications for Analysis of Creosote Oil," as it now stands in the Manual, be changed to read as follows: "Specifications for the Fractionation of Creosote Oil."

Outline of Work for 1912.

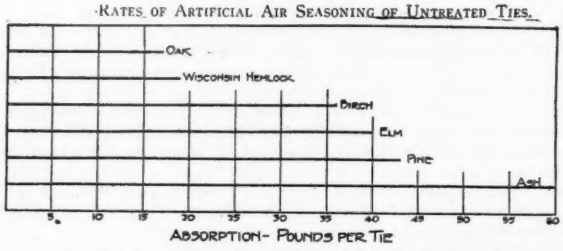
Your committee recommends:

(1) Continue investigations of the merits as a preservative of oil from water gas and the use of refined coal-tar in creosote oil.

(2) Continue the compilation of available information from Service Tests.



RATES OF ARTIFICIAL AIR SEASONING OF UNTREATED TIES.



ABSORPTION OF CREOSOTE (LOWRY PROCESS) OF AIR SEASONED TIES.

Northern Pacific Ry.

(3) Continue the investigation of the proper grouping of the different timbers for antiseptic treatment.

(4) Continue consideration of the revision of the Specifications for Fractionation of Creosote Oil.

(5) Report on the value of impregnation with crude oil.

(6) Report on the value of brush coating and dipping.

(7) Report on methods of accurately determining the absorption of creosote oil, including check of gage readings and the keeping of corrected records.

(8) That the Board of Direction assign the work of drawing up a Standard Specification for Timber for Treatment to a Joint Committee of the Committee on Wood Preservation and the Committee on Grading of Lumber.

APPENDIX A.

Grouping of Timbers for Antiseptic Treatment.

Chicago Tie and Timber Preserving Company.

The information furnished by this company cover the treatment of red oak and mixed beech ties by the Card process. The weights as given in the table are not taken from selected lots, but cover the daily practice. The cubical contents in each charge was estimated by displacement. The computations from the daily log sheets were made by the Forest Products Laboratory:

Oak—Card Process.			Beech (mixed)—Card Process. (includes gum, elm, basswood, etc.)		
Weight per cu. ft. Pounds	Absorption per cu. ft. Pounds	No. Ties used	Weight per cu. ft. Pounds	Absorption per cu. ft. Pounds	No. Ties used
42	14.6	2,670	37	20.6	567
43	14.3	7,516	38	18.7	1,723
44	14.6	19,472	39	21.6	571
45	13.7	32,727	40	18.5	2,818
46	13.8	32,498	41	19.3	1,707
47	13.8	10,323	42	18.4	3,972
48	14.4	1,569	43	17.4	1,702
49			44	17.0	5,114
50	13.9	1,113	45	17.1	3,414
51	13.3	2,228	46	17.2	3,982
52	13.2	1,668	47	15.7	4,027
53	12.5	2,308	48	15.6	4,553
			49	14.9	2,313
Total		114,092	Total		36,463

The table shows clearly that the absorption per cubic foot with both mixed beech and red oak ties falls off as the treating weights of the ties increase. Thus the absorption of red oak at 42 lbs. per cu. ft. is about 14½ lbs. of solution, and at 53 lbs. per cu. ft. about 12½ lbs. For mixed beech the difference is even more marked, varying from about 21 lbs. of solution at 37 lbs. per cu. ft. to 15 lbs. absorption at a treating weight of 49 lbs. per cu. ft.

Northern Pacific Railway.

The report submitted concerns the seasoning and treatment of pine, oak, beech, elm, ash and hemlock crossties at the Paradise, Mont., plant of the Northern Pacific Railway. The data were compiled by the Forest Products Laboratory.

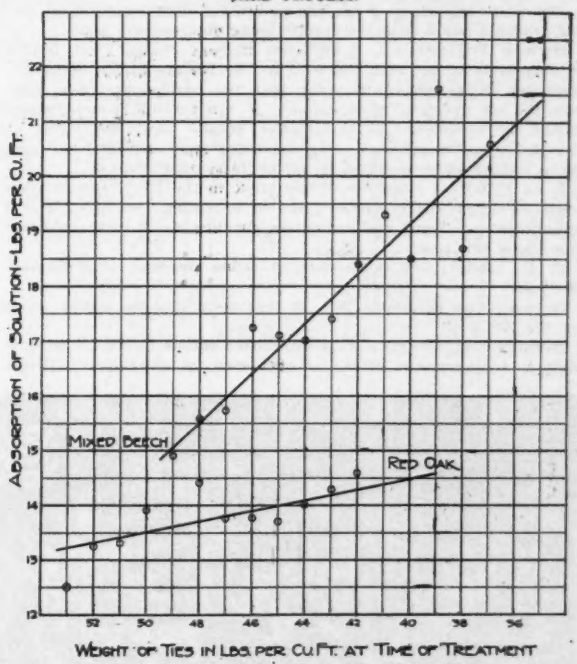
Two ties of each of the above species, with the exception of the birch and hemlock, of which four ties were used, were piled to air-season in a shed where the air was artificially heated. All were hewn ties 7 in. by 9 in. by 8 ft. and contained an average of sapwood for Minnesota timber. The ties were weighed from time to time to ascertain the rate at which they were seasoning; Fig. 1, in the accompanying diagram, showing graphically the results obtained. After the ties had seasoned to the minimum weight shown in the figure they were placed in the treating cylinder and given a Lowry treamtent, all being treated in exactly the same manner. Fig. 2 shows the amount of creosote absorbed by the ties under these conditions. Just before treatment the ties had the following weights:

Texas Tie & Lumber Preserving Company.

This company reports that the grouping and seasoning of pine ties, as described, is in connection with the Rueping empty-cell process.

"We have carried the segregation of pine timber a little further than is customary when we can do so and have tried to separate, when possible, ties that had more than 50 per cent sapwood from those that had less and treated them in different charges. Our ties at Somerville are also divided approximately 50 per cent hewn and 50 per cent sawn, and of our sawn ties we get approximately 65 per cent heartwood ties with very little sap, and of our hewn ties we get only about 10 per cent of long-leaf ties, which have very little sapwood on.

DIAGRAM SHOWING THE ABSORPTION OF RED OAK AND MIXED BEECH TIES AT VARIOUS TREATING WEIGHTS PER CU. FT. CARD PROCESS.



Basis 114,092 Red Oak Ties; 36,463 Mixed Beech Ties.
Treated by the Indiana Zinc-Creosoting Company, Terre Haute, Ind., July, 1909—January, 1910.

"In treating ties with the Rueping process we find, for instance, that we have to put in from ten to fifteen pounds more air in the sawn tie that are 65 per cent heartwood than we do in the hewn ties that are only 10 per cent long leaf, with small sapwood to leave in the same amount of oil at the finish of the treatment. We also find when we separate the hewn ties in saps and hearts that we have to make about 15 lbs. difference in the air to leave in the amount of oil when the tie is treated. This is about the extent of our findings on this subject, and it may not be of interest to those not using the Rueping process."

Discussion.

Hunter McDonald.—I think that this report should cover lumber generally, and the committee seems to specify ties in almost every case.

Earl Stimson.—Grouping applies more particularly to ties than to any other timber. Two thirds of the timber treated is railway ties. We will, however, change the wording if the Association so desires.

On motion of Mr. Stimson subjects 1, 2, 3 and 4 were voted on, separately, and carried.

Conclusion No. 1, concerning the grouping of timbers for treatment, was passed without discussion.

L. C. Fritch.—I would like to know why the committee allows three different grades of oil. What would be the difference in cost between No. 2 and No. 3 oil?

Earl Stimson.—We cannot give the difference in cost, that depends on market conditions. The idea was to define the different grades so that we would not pay first grade prices for third grade oil.

L. C. Fritch.—I think that two grades would be enough. The use of third grade oil will seriously affect the treatment, and the cost would not be very much less. Market conditions may necessitate two grades, but don't think it would necessitate three grades.

Earl Stimson.—As a matter of fact, lots of third grade oil is being purchased under a first grade price.

E. K. Bowser.—Many roads can get nothing but third grade oil, and they must have a preservative. That is the reason for the third grade oil.

Prof. S. N. Williams.—It seems to me the committee ought to give us some idea of the difference in the costs of these grades of oil.

W. L. Seddon.—Before we recommend these three grades, we ought to have some definite information as to their preservative values.

Earl Stimson.—Most of the oils now being used would come under grades 2 and 3, and the results being obtained are good.

Herman Von Schrenk.—I advocate the use of No. 1 oil, but it is impossible to get very much of it. So we are giving specifications for three grades, in order that the purchasing agent may buy the oil under a specification. If inferior oil is used, more should be injected. As the matter stands now, the value of the No. 1 specification is being detracted from, because so much oil is bought under it which is not up to the specification.

L. C. Fritch.—I think we should stick to the No. 1 specification until we know the probable effect of accepting the No. 2 and 3 specifications. Think the committee should give us more information along this line.

C. E. Lindsay.—Is it possible to refine Grade 2 or 3 oil into No. 1 oil?

Herman Von Schrenk.—No. If that were true we would insist on the No. 1 oil.

Herman Von Schrenk.—This committee stands for No. 1 oil, and simply recognizes the others as necessary for existing conditions.

Herman Von Schrenk.—The Grade 3 oil is a good preservative, better in fact than some used in Europe which has given a life of 25 to 30 years.

S. R. Church.—There is no essential difference between the different grades of oil. The reputation of creosote oil as a preservative was made before as high a grade of oil as No. 1 was produced. No. 2 or No. 3 can be refined to No. 1 grade, but the cost is excessive. There is no surplus of oil from which creosote can be obtained. There is plenty of antiseptic in the Grade 3 oil to preserve wood efficiently.

The specification was voted on and carried.

The election for officers resulted as follows: President, C. S. Churchill; Vice-President, W. B. Storey, Jr.; Secretary, E. H. Fritch; Treasurer, George H. Bremner.

ANNUAL DINNER, A. R. E. ASSN.

The accompanying photographic reproduction shows a large number of faces familiar to all interested in the American Railway Engineering Association. The annual banquet was held in the Gold Room of the Congress Hotel, Chicago,

Banquet of the American Railway Engineering Association.

on the evening of March 20. The attendance aggregated about 400 persons, railway officials and supplymen.

The toastmaster's chair was filled by W. C. Cushing, president of the association. The addresses were by L. F. Loree, president of the Delaware & Hudson Co.; F. D. Monk, K. C. M. P., Minister of Public Works of Canada; and Ray Morris, a member of a New York firm of bankers. The address written by L. F. Loree was read in his absence by G. H. Burgess, chief engineer of the Delaware & Hudson. Mr. Loree was prevented from attending at the last hour.

President Cushing, on behalf of the association, spoke in appreciation of the Coliseum exhibit. President Belknap of the National Railway Appliances Association thanked the members of the American Railway Engineering Assn. for their interest and attendance.

Creosote is only 3 per cent of the by-product from coke ovens and the manufacturers will not give it very much attention.

S. B. Fisher.—I think we should have a lower grade of oil, for our ties in some localities wear out before they decay.

The Association voted to adopt Grade 2 specifications. A motion was made to adopt Grade 3 specifications.

C. H. Spencer.—I have always stood for good practice, and I don't believe these lower grades of oil are good practice. We are told that more of the lower grade oil should be used. Are we able to, or will the plants, use more? When buying oil, the manufacturer will want to know why the No. 2 or 3 is not good enough. We say nothing of the relative value of these oils. I move that the Grade 3 specifications be referred back to the committee.

L. C. Fritch.—How are we to obtain heavier impregnation if we are now treating to refusal with No. 1 oil?

Herman Von Schrenck.—Does Mr. Fritch know that he is getting No. 1 oil?

L. C. Fritch.—If I am not it is my own fault.

C. H. Spencer.—This Association is not here to meet all conditions but to recommend good practice.

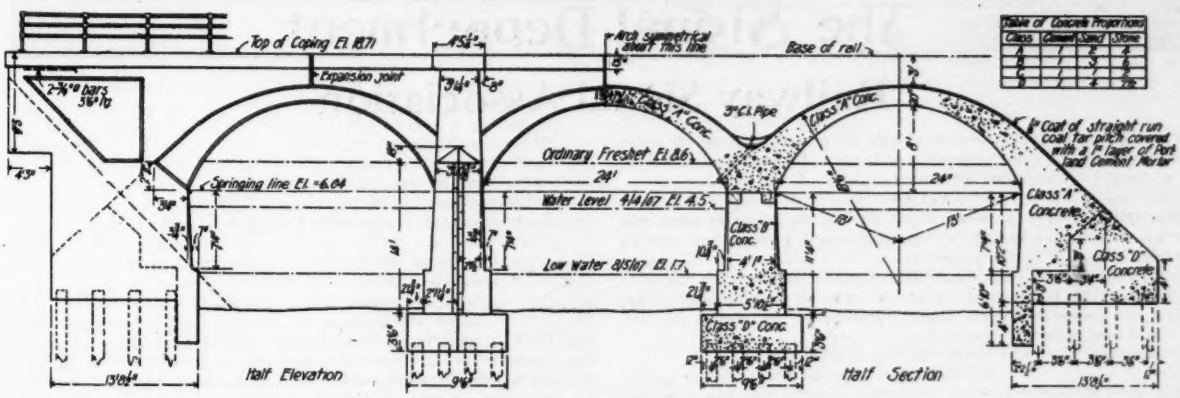
W. L. Webb.—This question is similar to buying grades of lumber. I think we should define No. 3 oil the same way that we define grades of lumber.

W. L. Seddon.—We know something about the different grades of lumber, but very little about these grades of oil.

L. G. Curtis.—It seems to me that the only way to settle these questions is to adopt the specifications and try them out.

The Atchison, Topeka & Santa Fe Coast Lines will construct a 25-stall roundhouse and trackage, water and drainage system at Barstow, Cal., to replace structures destroyed by fire. Approximate cost, $133,000.

The Buffalo Creek has adopted the Strauss bascule bridge design for a 165-ft. single leaf, double-track bridge over the Buffalo river, at Buffalo, N. Y.



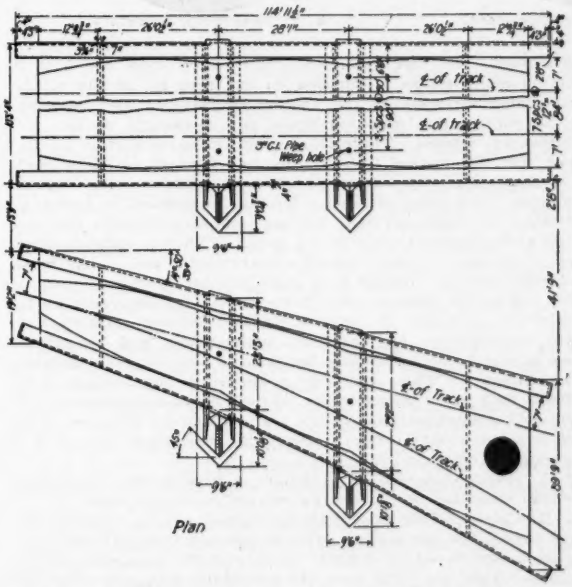
Three Arch Concrete Bridge, N. Y. C. & H. R. R.

THREE ARCH CONCRETE BRIDGE AT TROY, N. Y.

The New York Central & Hudson River has adopted concrete construction for a large number of structures. Ash pits of plain concrete have been adopted as standard. Other plain concrete structures adopted as standard types are arches, abutments, culverts, piers, foundations, passenger platforms, retaining walls, ducts, right of way posts in electric territory, and turntable pits. Reinforced concrete is used, but has not been adopted as standard, in the following structures: battery wells, arches, highway bridge approaches, chimneys, coaling stations, and retaining walls. Reinforced concrete has been adopted as standard for the following: passenger platforms and turntable pits.

In December, 1912, this company completed a three-arch concrete bridge over Poestenkill Creek, Troy, N. Y.

The arches are of plain concrete. The mixture used in the arch ring was 1:2:4 using crushed stone not larger than would pass a ¾-inch screen. The spandrels are solid concrete filled with ballast. The arch ring is made in circular segments. The concrete was designed for a compression stress of 500 lbs. per sq. ft. and a tensile stress not to exceed 50 lbs. per sq. ft. The forces assumed for the design of the arch ring were: dead load 150 lbs. per cu. ft. for concrete, 100 lbs. per cu. ft. backfill; live load 1,200 lbs. per sq. ft. Included in the 1,200 lbs. live load is an allowance of 25 per cent for impact.



Upper Plan Shows First Two Tracks of Eight Track Section.

The waterproofing for the arch consists of a coat of straight run coal tar pitch one-eighth inch thick, covered with a layer of Portland cement mortar, one inch thick.

The abutments are of plain concrete in a 1:4:7½ mixture, with ¾-in. broken stone. The face of the abutments have a batter of ½ inch to one foot, and the back of the abutment is plumb. No backwall was used. The stresses in the piles were the governing one in the design. The loads used in design were the same as in the arch ring.

The piers were made of concrete of two different proportions; 1:3:6 in the body walls, and 1:4:7½ in the footings. The starkwater is 14 feet high with a slope of 4 inches to 1 foot. Compression stress allowable in the concrete was 500 lbs. per sq. ft. The standard top width is 4 ft. 1 in. at springing line. The piers were designed to withstand that combination of stresses due to the dead and live loads in adjacent spans which gave the greatest compression in the concrete at the footing, adding the dead weight of the pier above to get the maximum. Expansion joints were placed in the spandrel walls over the crown of each arch. Transverse expansion joints were placed at the center of the arch barrel and at distances of 30 ft. either side of same. The expansion joints extend to the top of the foundations, and are made of one layer of tar felt coated on each side with ⅛ in. straight run coal tar pitch.

Concrete edges were rounded to a radius of one inch, except in cases where corners were bevelled. A 2-in. granolithic finish was put on all exposed surfaces, the mixture consisting of 1 part of Portland cement, 2 parts of coarse sand and 2 parts of granolithic grit.

Plans have been made for putting up a new station and freight sheds for the Intercolonial and the Dominion Atlantic at Halifax, N. S. The improvements include railway yards, terminals, bridges, freight sheds and a union station.

Preparations are being made for the construction of a passenger station at Hillsboro, Tex., for the joint use of the Missouri, Kansas & Texas, and the Trinity & Brazos Valley.

In connection with the contemplated changes in the New York Central lines through Tonawanda and North Tonawanda, N. Y., the company is planning the construction of a double-track swing bridge over the canal. The structure as proposed will be 600 ft. east of the present main line bridge.

A contract has been let to Grant, Smith & Co., of Spokane, Wash., for the construction of a union passenger station at Auburn, Wash., to cost approximately $75,000, to be used by the Oregon-Washington Railway & Navigation Co., the Northern Pacific and the Chicago, Milwaukee & Puget Sound.

In connection with the new railroad planned by the Ozark Land & Timber Co., in Arkansas, a new bridge will be constructed over the White River. George D. Locke, Rogers, Ark.

The Signal Department

Railway Signal Association

The Railway Signal Association held its stated meeting on Monday, March 18, at the Congress Hotel. The meeting was called to order by C. C. Anthony, President.

CONTRACTS.

The Committee on Contracts has held three meetings since the Annual Convention in Colorado Springs, one in December, one in January and one on February 14.

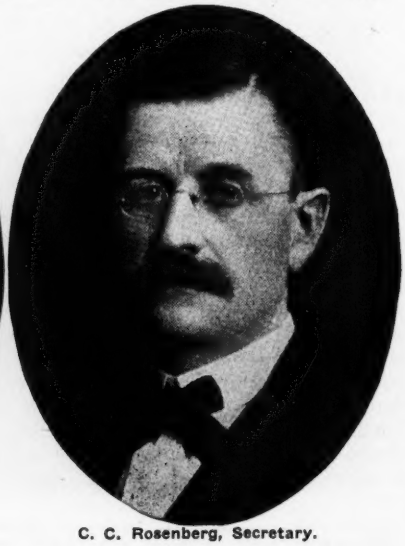
I attach hereto a preliminary statement of the relative value to be assigned to the various operated units at interlocking plants, which the committee would like to present at the March meeting of the Association for discussion.

The report is signed by L. R. Clausen, chairman.

		Manual Plant. Const.	Manual Plant. Maint.	Power Plant. Const.	Power Plant. Maint.
1.	Each One-arm, two-position signal	3.	1.	7.	1.
2.	Each additional arm on same mast	3.	1.	6.	1.
3.	Each one-arm three-position signal	3.	1.	6.	1.
4.	Each additional arm on same mast	3.	1.	6.	1.
5.	Each additional fixed arm	.25	.10	.25	.1
6.	Each fixed one-arm signal	1.00	.10.	1.00	.1
7.	Each Two-position power signal on manual plant	8.	2.		
8.	Each additional arm on same manual plant	7.	2.		
9.	Each one-arm dwarf signal	2.	1.	5.	1.
10.	Each additional arm on same mast	2.	1.	4.	1.
11.	Each single switch, two points, no levers, bars or locks	2.	1.	2.	1.
12.	Each single switch and lever, two points; no bars or locks	4.	2.	6.	2.
13.	Each derail and lever; no bars or locks	4.	2.	6.	2.
14.	Each single slip switch and levers; four points; no bars or locks	6.	5.	11.	5.
15.	Each double slip switch and levers; eight points; no bars or locks	10.	10.	14.	10.
16.	Each set movable points, frogs and levers; four points; no bars or locks.	6.	5.	8.	5
17.	Each detector bar alone; no lever	0.5	1.	0.5	1.
18.	Each switch and lock movement alone.	1.00	1.		1.
19.	Each facing point lock alone	.50	1.		
20.	Each detector bar on separate lever	3.5	2.	5.	2.
21.	Each facing point lock on separate lever	3.5	2.	5.	2.
22.	Each facing point lock, with one detector bar, one lever	4.	3.	5.5	3.
23.	Each facing point lock, with two detector bars, one lever	4.5	4.	6.	4.
24.	Each two facing point locks, with one detector bar, one lever	4.5	4.	6.	4.
25.	Each three facing point locks, with one detector bar, one lever	5.	5.	6.	5.
26.	Each torpedo placer, one lever	4.	2.	6.	2.
27.	Each drawbridge coupler, one lever	3.	2.	6.	2.
28.	Each drawbridge rail surface and alignment; lock and lever	3.5	2.	6.	2.
29.	Each drawbridge wedge and machinery; lock and lever	3.5	2.	6.	2.
30.	Each Cantilever bracket	.25	.10	.25	.10
31.	Each telephone circuit and phone	.5	1.	.5	1.
32.	Each switch indicator	2.	1.	2.	1.
33.	Each outlying switch lock	2.	2.	2.	2.
34.	Each time release—any kind	1.	.25	1.	.25
35.	Each tower indicator and control	1.	1.	1.	1.
36.	Each electric lever lock with control.	2.	1.	2.	1.
37.	Each D. C. track circuit, including joints, battery, relay	1.	1.	1.	1.
38.	Each electric slot for manual signal and control	1.	1.		

C. C. Anthony, President.

F. P. Patenall, Vice-President.



C. C. Rosenberg, Secretary.

Discussion.

L. R. Clausen—It has been the practice in the railways to apportion construction and maintenance charges according to (1) the number of roads involved; (2) cost of the material used on each road, or (3) according to the number of levers in each company's plant. The first system is unfair when there are 2 or 3 times as many tracks interlocked on one road as on the other. Apportioning expenses by the amount of material used may be fair for construction cost, but would not necessarily be fair for maintenance charges. There is so much material that is jointly owned that this method is frequently only a rough estimate. And the apportionment by this method is very laborious and takes a long time. The third method, according to number of levers is fair when the same methods are used on each railway, but are unfair where different methods are used. With this method, however, it is easy to take care of enlargements, and it has been used with excellent results in a large number of cases.

The committee suggests that there should be discussion as to whether it is desired to have a division between manual and power interlocking, and between maintenance and operation. These appear to be rather fine distinctions, and our table appears to be elaborate. Where there are a number of joint plants, it is probable that any reasonably fair system based on operated unit value will compensate and make the division of expenses just. Such a table would be fair in most any case, considered over a long number of years.

C. E. Denney—I would like to inquire as to what was adopted as the unit, assuming that it was figured out on a cost basis.

L. R. Clausen—This table was not figured out on a dollar and cents basis. We are getting data on this question, but the table presented was based on original tables and the experience of the committee members. The fixed one-arm signal has been given the value of one. It is immaterial as to which you assume as the unit, since the others are all relative.

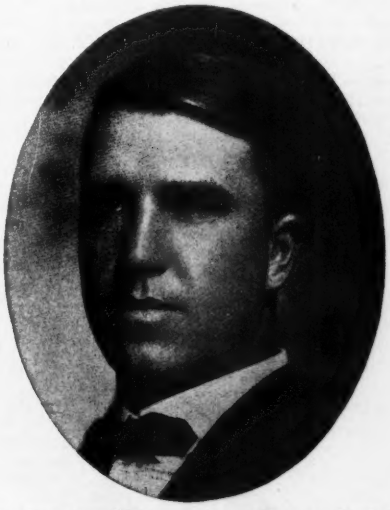
W. H. Elliott—We have found that the division for construction on a basis of costs, works out very satisfactorily. With this system no table of unit values is necessary. I think in general the maintenance charges should be apportioned according to costs. I favor a unit cost table only where a division has not been agreed on, or where a plant is already in operation and the costs are in question. Generally tables such as these do not work out well in practice.

C. E. Denney—I think the question as to whether this table will work out correctly in practice can be determined by securing figures from a large number of railways as to how it would work out in practice. I do not think we should go into detail too much in dividing a plant.

L. R. Clausen—In making up this table we used considerable available information as to cost of installing some of the units. The committee favors a table of unit values rather than a cost of material basis. The cost of determining the value of material is excessive, sometimes requiring two or three months. How can you divide the cost of a man's time working for an hour on one line and then an hour on the other, the cost of wires used by both lines, or the cost of the stock in the interlocking tower?

W. H. Arkenburgh—I think the items mentioned could be left out and apportioned later according to the material not joint. I believe maintenance would be more fairly charged on a cost of material, together with a traffic or wheelage basis.

F. S. Stevens—The idea is that in determining costs of material, we are liable to spend more money than is justified. We have found in 40 or 45 plants, the difference in the charges under different methods was not over $2,000 in the whole bill, which



L. R. Clausen, Chairman Committee on Contracts.

would be paid by one railway.

J. C. Beaumont—I think we should have a table of operated unit values as a basis of charges, and think the table should be carried farther, to take care of operation charge.

L. R. Clausen—The committee has not considered operating charges. I know of a case where $1,400 was spent to determine what material was used on the various lines.

J. C. Mock—I believe this table should be very complete before being adopted. Then when we have a particular plant we can take the unit values as they exist, from this plant.

C. E. Denney—I would like to call the attention of the committee to the charge for a one arm 2-position signal, which, irrespective of location is one, while the value of a fixed arm is 1/10. This does not seem consistent to me, considering that there is a lamp on the fixed signal.

L. R. Clausen—The lamp is an operating problem, and doesn't enter into this table. The table is based on approximate costs only, since these are not the same for all cases.

C. E. Denney—It seems to me many operating charges, such as taking care of lamps, for instance, could be divided on the same basis as the maintenance charges.

A. G. Shaver—Can the chairman give the reasons for the large difference in construction and maintenance charges between the manual and mechanical plants?

L. R. Clausen—The units are different.

C. E. Denney—I would like to inquire why we should have more than one table.

L. R. Clausen—We tried to cover all the points, and we want to know if the tables are too elaborate.

A motion made by Mr. Stevens, that a single table be prepared, was seconded by Mr. Beaumont.

J. E. Mock—I think the table should be very complete, and am not in favor of that motion.

The motion presented was withdrawn.

L. R. Clausen—We wish a vote on three questions: (1) Are separate tables necessary for manual and for power plants? (2) Are separate tables necessary for construction and maintenance? (3) Is this table too elaborate?

B. H. Mann—I think one table only is required, for the sake of simplicity.

The question as to the number of tables desired showed a majority in favor of separate tables for manual and power plants. The majority of members voted in favor of one table to cover both construction and maintenance. A majority of members voted against a larger table.

A. G. Shaver—I think the committee has covered the ground pretty thoroughly.

POWER INTERLOCKING.

Report of Sub-Committee "E".

Sub-Committee "E" of Committee III, submitted as a progress report the following changes in "Specifications for Electro-pneumatic Interlocking," as printed in Journal, Volume XIV, No. 4.

Clause 3. Drawings.

Under "(a) Purchaser's Drawings" insert between Exhibit A and Exhibit E the following:

Exhibit B. Plan No.....dated..... showing typical circuit for the control of power-operated signals and the following adjuncts:

R. C. Johnson, Chairman Committee on Power Interlocking.

Switch indicators, protection for facing and trailing switches, main line and siding cross-overs, crossing bells, train order signals and.....

Exhibit C. Plan No.....dated..... showing typical circuit for the control of semi-automatic interlocked signals and the following adjuncts:

Route locking, approach locking, annunciators, indicators, repeaters, track circuits and.....

Exhibit D. Plan No.....dated..... showing location of battery wells, battery chutes, junction posts and.....for typical signal and cut section location.

Clause 340. Detector Bars, General.

Substitute the following for paragraph (b) as printed:

(b) Detector bar shall be not less than eighteen (18) inches longer than the inside wheel base of the maximum equipment run over the road and shall be arranged to give continuous protection for all switches, derails, movable wing frogs and movable point frogs.

Clause 20. General Electric Requirements.

Substitute "two thousand (2,000) volts" for "three thousand (3,000) volts" in paragraph (a) as printed.

The report is signed by Robert C. Johnson, Chairman.

Discussion.

A. G. Shaver.—I think that the length of detector bar in 340 should be in feet, as we cannot expect a contractor to look up the largest equipment. I think the voltage in paragraph 20 should be the same as is being considered by the Sub-Committee on Relay Specifications, namely 5,000 volts.

C. C. Anthony.—Could not the length of derail be left blank with a note recommending method each railway should pursue in determining same?

T. S. Stevens.—That method would not necessitate changing specifications as the equipment changes.

W. H. Arkenburgh.—Sub-Committee A has reached the same conclusion as this Committee, but has specified a minimum length of 55 feet.

W. H. Elliott.—I don't think that this minimum should be specified, for in case an accident happens to a road with a shorter bar it would put the road in a bad light.

C. E. Denney.—I move that the length of detector bars be left blank, with no qualifying note.

A. G. Shaver.—I am afraid such a specification will lead to complications. This Association, with the information it has, can well state in a footnote what length of bar it believes to be good practice.

C. J. Kelloway.—The Committee on Mechanical Interlocking, after giving this question considerable thought, could not recommend any specific length. They state the bar shall give..... feet continued protection.

The motion to leave the length of detector bar blank was passed.

PRELIMINARY REPORT OF SUB-COMMITTEE NO. 1 OF COMMITTEE IV.

This Committee was instructed to prepare revised Specifications for Direct Current Relays, Lifting Armature, Neutral Type, and for Polarized Relays.

The Committee has held two meetings in Chicago, one on December 20, 1911, and one on February 7, 1912. The Committee has revised the specification that was submitted as information at the meeting in October, 1911, and in this connection has considered the discussion on this subject at that meeting. Some of the paragraphs have been changed and some combined with others, with the idea of bringing as far as possible the whole of each subject under one paragraph.

Tests are under way to determine what should be specified with regard to contact resistance, the best material to be used for contacts, air gap, pick-up, drop-away with and without contact pressure, contact opening and a reliable test for the quality of the iron in the magnetic circuit. These tests will, without doubt, be completed in time to complete the specifications for the annual meeting.

SUBJECT "A."

Specification for Direct Current Relays, Lifting Armature, Neutral Type.

1. Definition.

A relay is an electro-magnetic device with contacts for controlling electric circuits.

2. Purpose.

This specification is intended to provide for direct current relays, lifting armature, neutral type, to be used in connection with railway signaling. Each contact to carry not more than five (5) amperes at a potential not to exceed thirty (30) volts.

3. General Design.

(a) Relays shall be of a general design approved by the purchaser.

(b) All working parts shall be enclosed in a ventilated weather-proof, transparent, dust-proof case.

(c) The outside dimensions of complete relays shall not exceed the following:

AUTOMATIC BLOCK.

Preliminary reports were presented including the following specifications: "Specifications for Direct Current Relays, Lifting Armature, Neutral Type," "Specification for Steel Cross Arm Pins," "Specifications for Copper or Tin Plated Channel Pins."

Chairman of Committee, E. L. Adams.

Discussion.

T. S. Stevens.—I think it would be advisable to have a specification for wooden pins, as we must use them in damp climates.

A. G. Shaver (Chairman Sub-Committee).—The Committee will be glad to take up that point, but thought we would consider the iron pins first as it is the standard of the Western Union.

W. J. Eck.—Should not the detail in the lower left-hand corner of sheet 1166 be number 4, the same as on sheet 1165?

A. G. Shaver.—Yes. That will be taken care of.

H. S. Balliett.—I think that the Committee could omit the galvanizing specification, and refer to our complete specifications on this subject.

A. G. Shaver.—I think it advisable to give only the part of those specifications which are most to the point. This is one of Mr. Elliott's specifications, and I presume he has no objections to its use.

W. H. Elliott.—I am not sure this test (which is for galvanizing wire) is strong enough for galvanizing the steel pin.

A. G. Shaver.—I think the various committees on galvanizing should get together and harmonize this specification.

L. R. Mann.—I think we should investigate the specification of the Western Union for these pins, and adopt them if necessary. Thus we can get a pin already being made in quantities, and naturally cheaper than one which would have to conform to a new specification.

E. L. Adams (Chairman Sub-Committee on Relays).—This Committee has attempted to use all the suggestions given at the last meeting in making up this report. We have found a good deal of trouble this winter with relay rusting. Moisture has gotten under the galvanizing or paint protection and rusted the iron. The only way to prevent this seems to be copper plating.

T. S. Stevens.—I think we should protect the relays but don't think we should specify the method, for fear of arresting progress along this line.

C. E. Denney.—I think we should specify the coating for two reasons. The iron in the cores must be very carefully handled and some methods will injure it, and some methods do not have lasting quality. I think the committee should investigate this thoroughly before acting.

E. L. Adams.—The Committee has considered galvanizing (including sherardizing), painting, copper plating, and covering with shellac or varnish. We found the copper plate the only sure protection.

C. E. Denney.—Is the Committee still investigating this subject?

E. L. Adams.—This subject is to be given further attention and we are making tests now to determine if copper plating is best.

W. H. Elliott.—The copper withstands moisture better, I believe, if it is burnished and not merely buffed.

E. L. Adams.—It is our idea that the iron should be buffed, not the copper, to get a smooth surface for the copper.

W. J. Eck.—I think the definition for relay should be referred to the Committee on Definitions.

E. L. Adams.—The Committee on Definitions approve this definition with an addition of the words "one or more" after "controlling." I think that all committees should get together and formulate a uniform paragraph for the acceptance of material.

A. G. Shaver.—This clause is like that in other specifications, and allows an entire shipment to be rejected in case it is below specifications.

C. E. Denney.—The Committee having decided there are to be stop pins, I would like to know why they specify they are to be used with a radius of not more than $\frac{1}{16}$ inch.

A. G. Shaver, Chairman Committee on Automatic Block.

E. L. Adams.—In the specification the committee has considered cutting out the requirements of stop pins in the armature entirely.

A. G. Shaver.—The ventilation of the relays, paragraph 3, is an important thing to be brought up. In my experience it has been one of the most troublesome things we had to deal with. We have ventilated the relays and our general reports are in favor of it, but we sometimes get reports that ventilated relays are not so good as the others. In the opinion of some engineers, it is necessary to close them up as tight as possible to prevent dust entering.

G. E. Beck.—Do the so-called ventilated relays have openings at the top and bottom or merely at the bottom?

L. F. Howard.—I suppose the relays have openings at the top and bottom.

A. G. Shaver.—Have you received sufficient information to know what ought to be done with them, or if the whole road is still equipped with them?

L. F. Howard.—We have not enough data to answer that question, but I would say that ventilated relays were desirable.

H. S. Balliet.—I assume Mr. Howard means in other places than in tunnels, or protected railways; in other words, in the open country.

A. G. Shaver.—We have had considerable experience with relays ventilated and not ventilated, and I have not been able to notice much difference. I believe, however, that a ventilated relay will give better service than one that is not ventilated.

C. E. Denney.—We have had a number of cases, particularly this winter, where relays ventilated and relays that were supposed to be air tight have sweat. In a good many cases there was much water in them, which, we think, did not come from the outside.

L. R. Mann.—I have seen no trouble where the relay case was put on the relay support with U-bolts.

H. S. Balliet.—I have seen cases where the relay has been in trouble on account of sweating fastened with the U-bolt. I believe from observation that a relay contained in a wooden box, on the side of the right of way, removed from the sun's rays, is the only cure.

J. J. Craig.—With a ventilated relay you will have moisture on certain parts. I don't think we ought to allow free circulation at the top and bottom of the relay, because that will induce a breathing action, and moisture will be deposited on the box and it whatever would not sweat the next winter in the same location. I think it is the atmospheric condition that causes the sweating in certain locations.

L. R. Mann.—I know of a relay that was sweating in one case and it was removed to another case and did not sweat. They ventilated the case and there was no more trouble.

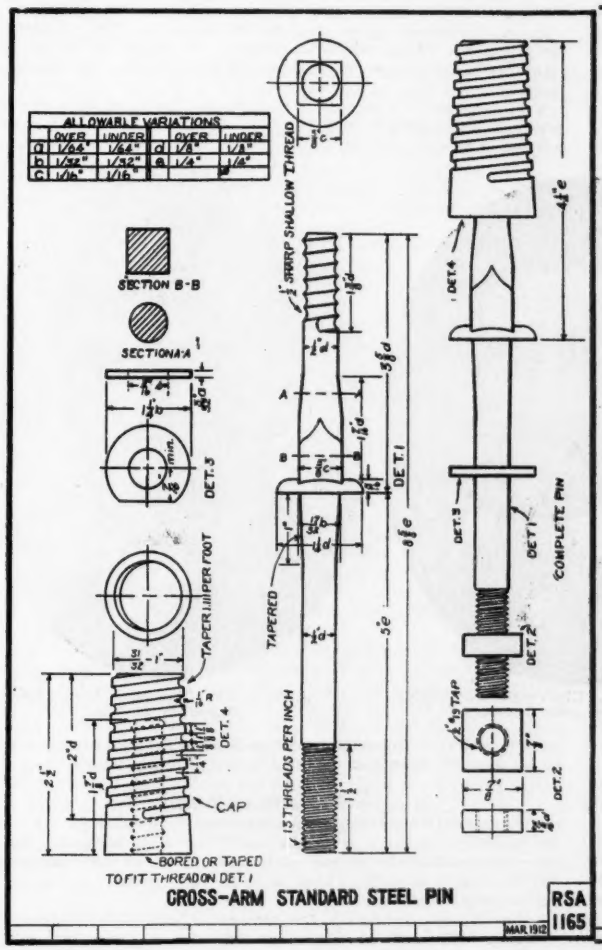
G. H. Dryden.—We have no trouble from sweating; our relays are all located in wooden boxes.

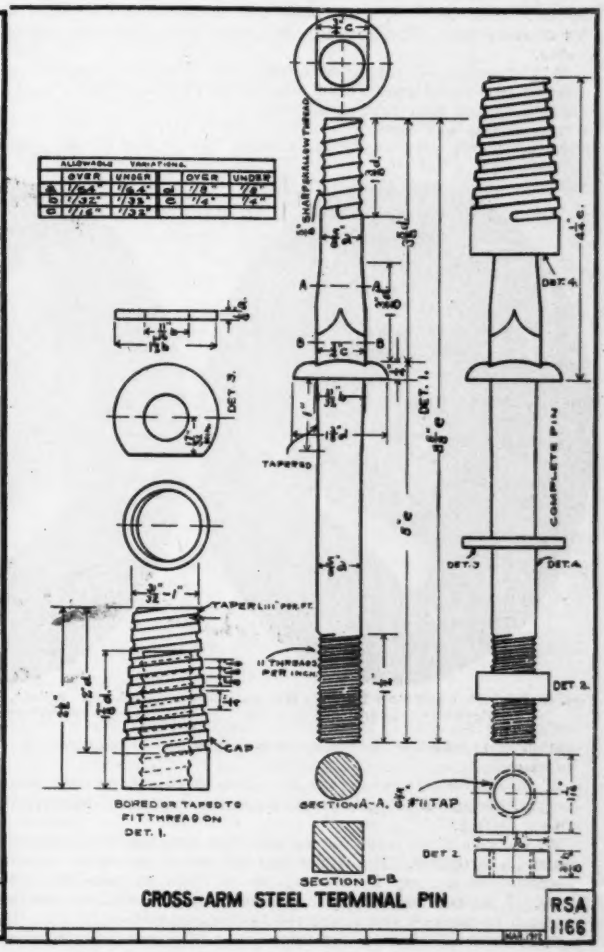
H. S. Stevens.—I can also say we have had no trouble reported from this cause, and our relays are all installed in iron relay boxes.

G. B. Gray.—So far as I know, the only ventilation our relays have is a small hole in the case, and we are not experiencing any trouble that I know. Most of our relays are in the wooden case, but a good many are in the iron relay case.

E. W. Newcomb.—I think all magnet coils should be flexible instead of annealed, and that terminal connections should be provided to connect on the binding post.

A. G. Shaver.—I suggest that the various committees concerned with electric apparatus, which requires a test of high tension





soak through. It seems if there is any moisture in the relay it should be allowed to run right out.

J. A. Johnson.—I would not recommend the relay ventilated at both top and bottom. I think there must be a mistake about the relays that are sealed up tight, as I do not think they are air tight.

A. R. Fugina.—I have found much less condensation in ventilated relays than in the non-ventilated relays. We have rebuilt the majority of our relays, ventilating them with a small hole in the bottom of the case, and have found that that has remedied our trouble in great measure. We still have more or less condensation, but only a fraction of what it was originally. We have this trouble in wooden cases and iron cases. I am satisfied that we must have a ventilated relay, but not one ventilated at the top and bottom.

E. W. Newcomb.—We have had cases where relays sweated in one location one winter, and the same relay with no changes in current, should get together and fix upon some voltage or voltages for tests of apparatus that are common to various specifications. A number of members do not agree with Mr. Stevens. Some of the manufacturers have objected to cutting out the views on varnished paper or varnished cambric, as they say it is not affected by moisture. There is a difference of opinion here.

E. L. Adams.—The opinion on varnished cambric and paper was not put in there because it is affected by moisture, but on account of physical conditions. If you use varnished paper for insulation and shove a binding post through it, it makes a dangerous condition.

L. R. Mann.—I would like to ask if the ⅜-in. air gap is sufficient for the binding post of the conducting line of the circuits for lightning protections?

E. L. Adams.—Three-eighths inch has been the standard spacing and the committee has not spent much thought on it.

Copper or Tin-Plated Channel Pins.

A. R. Fugina.—The only specification we have had is one for tin-plated pins. The instructions were to make this specification apply to copper-plated pins, to correct the design of the present channel pin, and to design a new channel pin gauge.

I want to make a correction in the heading, i. e., we should specify for copper-plated or tin-plated pins. We were instructed to embody in this specification a chemical test for copper plating; we have spent a great deal of time on that and had a good deal of correspondence with manufacturers, but have been unable to arrive at a satisfactory specification for copper pins.

C. E. Denney.—I suggest that paragraph 4 on Plateing be made to read, "The pin shall be plated with ———." That makes it part of the specification rather than instructions.

A. R. Fugina.—Certain manufacturers contemplate sending pins out in boxes of two hundred or five hundred, having them thoroughly oiled so they could be handed out to the maintainer accordingly, and he was to carry the little box with him.

C. E. Denney.—I move that all pins should be plated.

Motion carried.

C. E. Denney.—You can ship pins in oil and put a lot of oil around them, but before the men use up the pins they have a lot of rusty ones. The plating is to protect them from rust before using.

F. P. Patenall.—If plating is applied to prevent rust, there is no need of pins being dipped in oil previous to shipment, and I would make a motion that that be eliminated.

The motion was carried.

A. R. Fugina.—We would like to have the opinion of the association as to whether the copper plating specified in paragraph 5 is satisfactory.

A. G. Shaver.—It is evident that the paragraph is not satisfactory, because nothing is stated as to the method of testing the copper plating.

W. H. Elliott.—It seems to me that this wording of the specification is sufficient. The slight number saved by more careful methods will not pay for the expense of going to more complete tests. I move you that the present design of channel pin be changed to the new one submitted by the committee.

F. P. Patenall.—Before that motion is acted on I think, if there are any manufacturers of channel pins here, we ought to be told whether the change as proposed is going to have any result on the pin.

J. M. Walron.—I cannot see why a design of that sort should be changed without satisfying ourselves that it is going to be an improvement over what we now have.

Upon vote, the motion was unanimously carried.

COMMITTEE VIII.—ELECTRIC RAILWAY AND ALTERNATING-CURRENT SIGNALING.

Report of Sub-Committee C.

Subject Assigned.

Prepare Requisites of Apparatus and Material for an Alternating Current Automatic Block Signal System. (Applicable to all systems except where Alternating Track Circuits are in use on Alternating Current and Direct Current propulsion Lines.)

The committee presented a list of apparatus and material required for an alternating current automatic block signal system.

Chairman of committee, H. S. Balliet.

Discussion.

H. S. Balliet.—Sub-Committee A handles all of the alternating current signaling on railways using a. c. propulsion. Sub-Committee B handles the alternating current on roads using d. c. propulsion. We now have Sub-Committee C's report to cover so-called steam lines.

H. S. Stevens.—In paragraph B the association decides for the upper right-hand quadrant. I hope the cause of alternating current signaling is not going to be stopped on railways with lower quadrant signals.

H. S. Balliet.—The recommended practice of the association is the upper right-hand quadrant. It was the intention in the requisites for this particular report first to give the manufacturers an outline of what we require, then to go back and by a series of conferences to fill in the blanks.

Mr. Waldron.—Under paragraph (b), section D, "To be capable of continuous operation at 10 per cent under normal frequency," had that not ought to be "10 per cent over normal frequency?"

J. E. Saunders.—I think we ought to have 10 per cent variation either way.

H. S. Balliet.—The committee accepts that and will say plus or minus.

H. S. Stevens.—I move that paragraph as to the 90 degree indication be eliminated, first, because it cannot be done, and second, for the reason that it is out of place in the specifications.

A. G. Shaver.—I wish to ask if this completes the relay specification or if the committee expects to cover it in the general specification of relays.

H. S. Balliett, Chairman Electric Railway and Alternating Current Signaling.

W. H. Elliott, Chairman Committee on Wires and Cables.

J. C. Mock, Chairman Committee on Standard Design.

H. S. Balliet.—The committee has in mind that we are not ready to tie any manufacturer down to manufacturing details.

WIRES AND CABLES.

This committee presented specifications in preliminary form for consideration of the association, as follows: "Specification for 30 per cent conductivity copper clad steel drawn wire." "Specification for copper clad steel bond wire."

Chairman of committee, W. H. Elliott.

Discussion.

W. H. Elliott.—I move that we eliminate the word "but," so paragraph 1 will read: "Having 30 per cent of the conductivity of that of pure copper." This table of resistance is that which was given by the manufacturer and is based not on the exact standard, but on a standard with 98 per cent conductivity of the copper.

J. E. Saunders.—Figuring on the conductivity of 97 per cent standard for hard drawn copper wire, it averages 27 per cent conductivity, not 30.

W. H. Elliott.—The manufacturers claim they are not able to draw wire to exact conductivity, and they will furnish anything having a conductivity to within 5 per cent of that specified.

J. Beaumont.—For several years we have been using 40 per cent copper wire. The manufacturers have no difficulty in making wire that is 30 per cent conductivity. There is no reason why a manufacturer should furnish a 27 per cent wire for 30 per cent wire.

C. E. Denney.—Paragraph 9 means, in substance, that if a coil does not meet the requirements, you can cut off a piece and see if the piece you have left meets the requirements.

W. H. Elliott.—The manufacturer withholds the privilege to

withdraw the coil, or to have the piece cut off until it is of the proper conductivity. Tests made at the factory show that a certain thickness of copper is reached by cutting off the ends, and that that thickness is practically even until you approach the other end.

J. E. Saunders.—The purchaser is protected in the next page, where we specify the minimum length of coil.

Mr. Waldron.—Is there anything in these specifications which guarantees that the wire will be copper clad? As I read them, there is no guarantee that the copper was surrounding the steel and that all the parts of the copper would be practically of the same thickness. It appears to me that the manufacturer could beat the specification at almost any place he saw fit.

W. H. Elliott.—The thickness of the copper coating is sufficient to be determined by the eye and is readily perceptible on filing an end of the wire. A visual examination is much more definite and distinct than any chemical test, and it is by far the best method to examine the end of the wire and see what the thickness of the copper is.

Mr. Waldron.—I am inclined to doubt the advisability of testing visually. The copper being so much softer than the steel, it seems to me that it is liable to overlap the steel.

W. H. Elliott.—I am sorry I did not bring with me samples I had of 30, 35 and 45 per cent wire of the copper. There is no difficulty in detecting by your eyesight the approximate thickness of the copper. There was a difference of opinion as to whether or not it was advisable to put in different variations in the breaking strength and limit of the resistance, but we deemed it best to allow the purchaser to use his judgment if he desires to accept anything else than the exact specification requires.

B. H. Mann.—I think the committee ought to go a little deeper into the matter in section 9. I do not see why we should not ask the manufacturer to cut a certain number of feet off each coil, allowing them to try out its conductivity and keep on cutting back until the thickness of copper is enough to give the 30 per cent conductivity.

Mr. Waldron.—The manufacturer does not know how much of the end of each coil he must cut off. I think that some method should be provided for guaranteeing a uniform thickness of copper being put on the steel wire.

C. E. Denney.—I agree that there should be a specification for a minimum coating of wire. I move that paragraph 9 be eliminated. Motion carried.

B. H. Mann.—I move that an item be put in the specification that defective ends be cut off before they are put up for test at all.

C. E. Denney.—Has the committee looked into the matter of the minimum coating of copper at any point on the wire?

W. H. Elliott.—We got very complete data on that point and decided that visual examination was sufficient to tell whether the copper was evenly distributed. The difference between 30 per cent and 50 per cent conductivity is only about .015 or .020 of an inch, and it is very difficult to tell what the exact conductivity is on examination of the sample.

Mr. Waldron.—Has the committee tried chemical tests in connection with determining the thickness of the copper?

W. H. Elliott.—The amount of copper dissolved was .002 grams, and the amount of copper to one foot of the wire was about 7.5 grams. With the strength of acid proposed, it would require a test of 26 days to show whether the amount of copper had been placed around the wire.

C. E. Denney.—Why is it necessary to have bond wires which vary from 30 per cent to 50 per cent in conductivity?

W. H. Elliott.—The manufacturers claim that the bond wires are a by product, that they use scrap ends having a conductivity anywhere between 30 and 50 per cent, and that for bond wire purposes one answers just as well as the other.

C. E. Denney.—I know a manufacturer who said that the requirements had become so great they had to draw a wire especially for bond wires and cut it up.

W. H. Elliott.—I have a letter from a manufacturer stating just what I said, and it seemed to the committee that the point was good, that for bond wire purposes a conductivity between 30 and 50 per cent was immaterial.

W. H. Elliott.—The specification for "Armored Submarine Cable for High Tension Circuits" is a combination for the high tension aerial cable, with requirements that apply to submarine low tension cable. The tables on "Electrical Tests of Rubber Insulation" and "Temperature Coefficient of Resistance" are intended to make this part of the specification for mineral matter, rubber compound, insulated signal wire so that an inspection in testing wire at the factory may make resistance curves to standardize the results.

PRELIMINARY REPORT OF COMMITTEE ON STANDARDS.

The Committee on Standards submitted the following drawings:

1056—Terminal Block.
1060—Rocker Shaft Arms.
1061—Rocker Shaft Bearings.
1062—Rocker Shaft Assembly and Details.
1098—Detector Bars (Mech. Int.).
1099—Detector Bars (Mech. Int.).

The report was signed by J. C. Mock, chairman.

Discussion.

J. C. Mock.—The binding post is to supersede plan 1055, which showed a U-bolt in the terminal block that was found to be a little too light.

A. R. Fugina.—I do not understand why a U-bolt would not be better.

J. C. Mock.—This can be used to separate the circuits and is easier to manipulate, less liable to break when mounting it on the boards, and has the advantage of being able to connect several of the lines. It is more flexible and not any more expensive.

C. E. Denney.—I move the approval of plan 1056.

W. H. Elliott.—With the link in the lower position underneath the wire it is necessary to move the wire each time the link is open to test the circuit, and I think it would be better to show the connecting links above the open space for the wire.

J. C. Mock.—That is the way the draftsman shows it, but you can place it any way you like.

Plan 1056 was adopted.

J. C. Mock.—This plan of rocker shaft arms relates to the bending of the arm of a rocker shaft and has been gone into very carefully. This design has been tried out and found to be the best bend for this length of arm.

Plans 1060, 1061 and 1062 were approved.

J. C. Mock.—The committee on Mechanical Interlocking recommended a bar as shown on plate 1099. The reason for our designing this bar with a bend rather than straight is that it is a better mechanical device, has fewer parts and is quite as efficient.

C. E. Denney.—I think there should be a provision for a shorter bar than 55 ft. If you are going to use 50-ft. or 45-ft. bar, there is no reason why two sections cannot be made standard.

J. C. Mock.—The middle section in plan 1098 is to be a straight piece of variable length, although shown as 18 ft. 8 in. The specification will be that two of the bars will be 18 ft. 8 in., offset at one end, to be bolted to the other piece, a straight bar of variable length.

C. E. Denney.—We are using a half-inch bar and I think this plan should be revised to provide for ⅜-in., ⅞-in. and ½-in. bar, and, also, in place of the 18-ft. 8-in. dimension on the straight bar, to provide for any length of dimension.

W. H. Elliott.—I make a motion to that effect.

B. H. Mann.—While perhaps it does not make much difference when buying bars from the signal company, it makes a good deal of difference in the field. Repairs can be very much better done, and done by the average man with a very few tools, if you use this as a standard.

A. R. Fugina.—Is it proposed to make the length 55 ft.?

J. C. Mock.—There is an error in the dimensions on the last piece—it should have been left blank.

The President.—There is a motion before the association that the thickness of the bar should be covered by a note providing ⅜ in., ⅞ in. and ½ in. and that it is considered preferable that no length should be given.

W. H. Elliott.—I would eliminate the ⅞ in. and make it ⅜ and ½ in., in my motion.

The motion was carried.

REPORT OF SPECIAL COMMITTEE ON STORAGE BATTERY.

The Executive Committee instructed this committee as follows:

(a) In consultation with representatives of manufacturers, review adopted specifications and designs for storage batteries and recommend such revisions as may be necessary to make them complete.

(b) Investigate jelly electrolyte.

This committee should have some matter under (a) for discussion at the March meeting.

In addition, the president, under date of December 20, 1911, requested that the committee investigate and report on various methods of charging.

A joint meeting of the committee with the manufacturers was held in Buffalo on January 10, 1912. Messrs. T. L. Johnson, R. B. Ellsworth and the following battery company representatives were present: Mr. W. E. Winship and Mr. I. M. Noble, of the Gould Storage Battery Company; Mr. W. P. Hawley and Mr. A. O. Heister, of the United States Light & Heating Company; Mr. F. S. Gassaway, of the Willard Storage Battery Company; and Mr. L. H. Flanders, of the Electric Storage Battery Company.

A very satisfactory discussion was held, covering the details of the portable specifications as now being considered by the association. A number of very good suggestions were made as to how the specifications should be improved, both in order to secure a more satisfactory and uniform battery and to allow the manufacturers to reduce the cost of same.

Those present assured the committee of their co-operation to the end that satisfactory progress might be made in the investigation of this subject and the preparation of the necessary specifications.

A second meeting was held in Buffalo on February 7, 1912. Messrs. T. L. Johnson, G. E. Beck, T. J. O'Meara and R. B. Ellsworth were present and decided upon this report.

Discussion.

L. R. Mann.—It is stated that the preliminary reports received in regard to jelly electrolyte were inconsistent. Were the reports received on jelly electrolyte all for automatic block signal service?

R. B. Ellsworth.—The use of the jelly electrolyte in signaling is limited. The committee wishes to investigate the matter further before making a definite investigation.

L. R. Mann.—When we started the use of the jelly electrolyte some manufacturers discouraged the idea. However, we have had the jelly electrolyte in service for three years and absolutely nothing of a detrimental character has occurred yet.

G. E. Beck.—The jelly electrolyte was introduced primarily to prevent leakage in broken jars. The trouble with jelly electrolyte has been the drying out of the jelly, and while it does decrease the capacity, the capacity is not used in any event, so that the decrease does not amount to anything.

INTERLOCKING AT GEORGES CREEK, WESTERN MARYLAND RY.

By E. E. Bradley, Sig. Eng.

The Western Maryland Railway has just put in service an all electric interlocking plant at Georges Creek Junction, Maryland, a junction point one and one-half miles west of Cumberland.

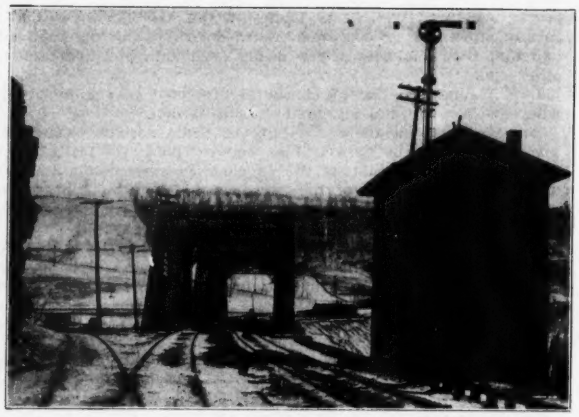
At this junction point is the Georges Creek and Cumberland Railroad, the Pennsylvania State Line branch of the Georges Creek & Cumberland Railroad, which the Pennsylvania Railroad uses into Cumberland, and the beginning of the Western Maryland Railway's new eighty-seven mile extension to Connellsville, Pa., where it connects with the Pittsburg & Lake Erie Railroad.

The material for this plant was furnished by the Union Switch and Signal Company and the work was installed by them. The machine has a 32 lever frame with 26 working levers and 6 spare spaces.

The machine is the U. S. S. latest multiple unit type and is equipped with electric detector circuits in lieu of detector bars.

Power for operating the plant is derived from 55 cells of chloride accumulator type 11 E storage batteries, these being charged by a 5 KW General Electric generator direct connected to a 7½ horse power, single phase, 220 volt, 60 cycle induction motor. Power for the motor is taken from city plant.

Three-Arm Home Signal.



Tower from the East.

Seven cells of the same type of battery are used for operating relays, bells, annunciators, indicators, etc. Approach and route locking circuits are installed throughout. The three-position speed signaling system, upper quadrant aspect, is used throughout, the upper arm of all signals controlling the highest speed route only; the second arm or medium speed blade controls routes where considerable speed, but not the maximum, may be maintained. The low speed arm in all cases leads to routes where conditions prevent them being used at any but low rate of speed.

Solenoid dwarf signals are used. Low speed arms and dwarf signals are two positions, 0 to 45.

The tower is electric lighted and the wiring is so arranged that tower lights can be switched to high voltage battery in case of interruption of city service.

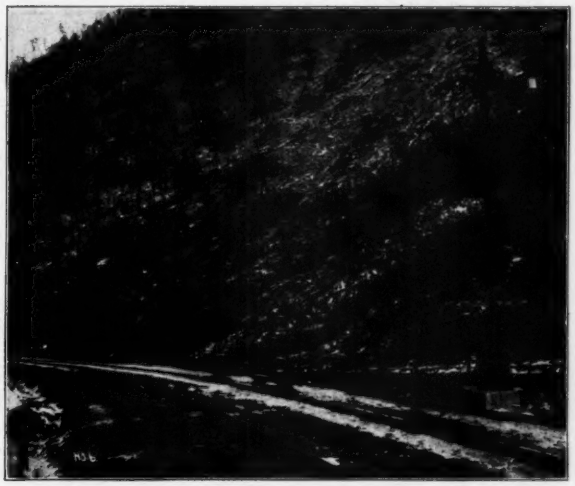
All wires between motor generator-set, switchboard, starting box and battery room are run in loricated iron conduit; all condulets have procelain covers with openings for each wire.

Tower from the West.

In front of the machine is an oak cabinet on which are grouped the bells, annunciators, indicators and clock-work time releases; all wires to this cabinet and operating switchboard are also run in loricated iron conduit.

A train order signal is located at the tower and is pipe connected to a dwarf machine in the building.

The location of this plant is in the "Narrows," one of the most picturesque places in the Alleghany mountains, and



Distant Signal.

through this gorge pass four railroads, the Baltimore & Ohio, the Cumberland & Pennsylvania, the Western Maryland, and the Cumberland & Westernport Electric Railway.

The old National pike also passes within a few feet of the tower, as seen in Figure 6. This pike was built by the Government about one hundred years ago; it was 60 feet wide and at one time was the most traveled road in the United States.

Figure No. 4 shows a distant signal location and the mountain in the rear. This mountain is 1,500 feet high at this point; on one side of this mountain can be seen an inclined railway up to one of the stone quarries.

26 Lever Machine, Georges Creek Interlocking.

It is said that the Lehigh Valley is planning to build a reinforced concrete grain elevator at its terminus in New York harbor.

The Missouri, Kansas & Texas, it is said, has engineers investigating the feasibility of constructing a bridge over the Colorado River at Austin, Texas, in connection with a contemplated extension of the line south.

It is reported that surveys have been made at Las Vegas, Mex., for the construction of the proposed international railroad bridge that is to connect Mexico and the United States and will be built by the National Rys. of Mexico and the Kansas City, Mexico & Orient.

It has been announced that the Northern Electric will commence work immediately on the construction of the joint bridge at Meridian, Cal.

IMPROVED BONDING DRILL.

The Kalamazoo No. 4 Bonding Drill as illustrated is especially designed for use on railroads using track circuit or block system and where it is necessary to drill holes in the rails for bonding. It has many very desirable features which will be easily understood by the engineers in charge of such work as well as the men who have the work to do.

1st.—By a simple ingenious arrangement, the machine can be attached or detached from the rail in a moment's time, by simply throwing back a lever which leaves the machine free and it can be taken direct from the rail instantly.

2nd.—The automatic feed machanism, which is continuous throughout the drilling of the holes, is a new departure and is a very desirable feature in our machine.

Kalamazoo Bonding Drill.

3rd.—The feed mechanism can be released instantly by the operator and the drill brought to its normal position for drilling the next hole.

4th.—The machine is simple as well as durable and is light, so that the operator can get the great efficiency required. The spindle has a ball thrust bearing which reduces the friction to a minimum.

This bonding drill is one of the products of the Kalamazoo Railway Supply Co., Kalamazoo, Mich.

The Southern will make temporary improvements for handling passengers during the annual reunion of the United Confederate Veterans, to be held in Macon, Ga. The work includes new baggage rooms, extensions to platforms, and enlargement of ticket offices.

The Maintenance of Way Department

BULLETIN OF THE ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

The Roadmasters' Association issued in March the first number of the Maintenance of Way Bulletin. This publication is to be published quarterly by the Association. A. M. Clough, president of the Association, gives the following reasons and objects in issuing the bulletin:

"Just previous to the meeting of the Executive Committee of the Association in Chicago last October, with Mr. Ryan, our secretary and treasurer, I looked over the situation and found that the only publication issued by the Association was the Book of Proceedings, usually distributed about the middle of December or later, containing a lot of advertising and our own discussions at the Convention in September. The proceedings appeared so late that the gist of it had appeared in the Technical Journals, the interest was gone, and about all the purpose the book served was to file away; so it was decided by the Executive Board to issue the Book of Proceedings without advertising just as soon as possible and then issue an Official Program of our next Convention containing the advertising formerly in our Book of Proceedings, all our papers for discussion and announcements of our social functions not later than July 15, requesting our members to keep this book before them and bring it along with them to the Convention. We also decided to issue between the two publications above mentioned a bulletin to take the place of the many letters that formerly passed between the secretary and the members. We consider it more up-to-date, less expensive in the end, a better advertising medium for our patrons and very much more interesting to our growing membership and at the same time a channel through which they can add a contribution to our track literature in their own way."

SURFACING.

Editor Engineering:

To lift and surface tracks with economy, conditions of the lift and kind of material used for ballast should be carefully considered, as well as the amount of traffic and speed of trains passing over the track where the work is in progress. Faster progress can be made with gravel ballast than can be made where stone ballast is used. The size of the gang or the number of men employed will be governed by the amount of ballast furnished. Fifty men, one foreman and an assistant foreman, make a very good lifting gang; this number, however, can be increased or decreased to good advantage as conditions may require.

Working in stone ballast with a lift of from 5 to 8 inches, each man on my lifting gang raises 66 lineal feet a day, including lining, leaving the track in first-class condition at the end of each day's work. All trains are flagged or slowed down during the time that track is being lifted; full speed is allowed at night; that is, the track lifted each day is put in condition before stopping work at night to allow full speed.

I have a gang of fifteen men following up and surfacing behind the lifting gang; this gang is a distance of one mile or more behind the lifting gang, and does all tamping with tamping picks, lining and making a complete finish.

In this manner the surfacing gang will be 2 or 3 days' work behind the lifting gang; the track after being lifted has that length of time to settle before being reached by the surfacing gang. I find the above method of handling the work gives best results.

Roadmaster, Michigan Central.

RENEWING TIES TO FACE.

Editor Railway Engineering:

In looking over your February issue I notice your advocacy of renewing ties out of face. I am an old trackman with some experience on several railroads and I ilke to see these questions discussed, as it tends to a better enlightenment and towards economy. In this particular case I must disagree with your article "renewing ties to face" except indeed where they are all rotten for rail lengths at a place. Railroads are operated today the same as any other commercial business, i. e. for profit, and it is to their interest to get as much service from their material as is possible and consistent with safety. You are correct in saying that ties removed from a track are unfit for further use, but if left would give a year's service. If we take it out we will do as all others would do; pick it up and throw it away, thereby wasting the company's property to the extent of a tie serviceable for one year, and the renewal which for first class ties and labor at present prices would cost the company from 75c to 85c. This is exclusive of the old serviceable tie we threw in the ditch, for there is where it would go—once taken out.

As far as I have seen all first class trackmen are opposed to disturbing their surface, but by your proposition they would have to do so—either dig them all out or pull the spikes, jack up the rails and pull them all out, and pull in the new ones on the old bed. In this case you won't need much tamping and you will have a beautiful hump on your track, and in the other case where you dig them out, you will have as nice a sag. And when the roadmaster and chief engineer come along, you will be kept busy dodging your "identy."

The present high grade and high speed tracks of the fast lines were never perfected by such a method, and a foreman with six men to six miles of track could never keep in sight of his work. It would leave him fixing a few rails of track for a week at a time; and as he has six miles ahead of him, he must keep on the jump and not waste either time or material. If he has a few ties in reserve after the season—they should be piled nicely in dry places.

No, sir, I can't agree with your article on this subject, but your monthly should be in the hands of every experienced trackman who intends to remain with his business.

Roadmaster.

TIMBER PRESERVATION AT ILLINOIS UNIVERSITY.

Professor W. K. Hatt of Purdue University delivered an exchange lecture before the students and faculty of the college of engineering of the University of Illinois, March 6, on "Timber Preservation." He also gave an address before the freshmen of the college on "Mountain Railways."

About 40 students of the University of Illinois, pursuing courses in railway engineering or railway administration, have joined in forming the "Railway Club of the University of Illinois." The object of the club is to provide for informal meetings for a discussion of railway problems and to promote good fellowship among its members. The officers for the present semester are: H. E. Marquette, President; A. C. VanZandt, Vice-President; W. C. Sadler, Secretary; A. S. Nevins, Treasurer; E. L. Tinzmann, Sergeant-at-Arms.

The Batesville & Northeastern has recently been organized and will begin surveys for a 40-mile line, to be built from Batesville, Ark. Virgil W. Cook, president.

PORTABLE TELEPHONE SET IN TRACK WORK.

Wearying of the continued loss of time entailed by the inability of crews of stalled trains and of repair gangs to communicate with headquarters from places along the right-of-way, the Lehigh Valley Railroad has purchased over seven hundred portable telephone sets during the past year. Each train unit is furnished with one of these sets, as is each bridge crew and each track repair gang. The officials of the road state, without reservation, that the purchase of these sets is one of the most profitable investments the company has ever made.

One of the track repair gangs was sent out recently with its first portable set. The gang consisted of forty men, whose business it was to replace worn rails. The "Black Diamond" express, the "crack" flier of the Lehigh Valley, was due, according to schedule, just about the time the track foreman was ready to replace several rails. Under the old order of things, the track foreman would have waited until the "Black Diamond," which had the right-of-way, had passed, before beginning work. Having modern methods at his command, he communicated, by means of his portable set, with headquarters and learned that the "Black Diamond" was two hours late on account of a snow-slide. Knowing this, the foreman went ahead with his work, made the rail replacement and had ample time to move on to the next place of operation before the "flier" thundered past.

It does not take long for many incidents of this character, numbers of which occur every day, to make the telephone more than pay for itself in enabling the track gang to work to the highest possible efficiency. The bridge inspector can report minor troubles to headquarters and have a repair gang start toward the scene of action in less time than he could formerly reach a signal tower. In an emergency, such as a wreck, the train crew can communicate immediately with the dispatcher and give detailed information concerning the extent of the accident. The railroad officials can then make a minimum of delay, arrange for the rerouting of trains and the hurrying of the wrecking and relief trains to the scene.

Personals

A. F. Nichol succeeds J. B. Trenholm as division engineer of the Atlantic Coast Line, at Florence, South Carolina.

W. E. Morse, assistant general manager of the Chicago & North Western, has retired on account of ill health, and will be succeeded by S. G. Strickland, formerly general superintendent. W. J. Towne, formerly engineer maintenance of way, has been appointed general superintendent. H. H. Decker, division engineer at Winona, succeeds Mr. Towne, as engineer maintenance of way. The offices of the above are all in Chicago. M. E. Thomas, division engineer at Madison, Wis., has been transferred to Winona, Minn. George B. Vilas, superintendent at Madison, has been transferred to Chicago as assistant superintendent, a new office. S. S. Long, division engineer of the Ashland division, has been transferred to Madison, to succeed Mr. Thomas. W. J. Jackson has been appointed division engineer of the Ashland division, office at Antigo, Wis. E. E. Nash succeeds Mr. Vilas as superintendent at Baraboo, Wis., and J. E. Doyle succeeds Mr. Nash at Winona, Minn. H. E. Dickinson has been transferred to Huron, S. Dak., and is succeeded by H. Rettinghouse, formerly division engineer at Boone, Ia. W. B. Linsley has been appointed superintendent at Chicago, and is succeeded by C. E. Andrews, who is appointed superintendent at Green Bay, Wis. A. N. Lacomb succeeds Wm. Andrews as superintendent, office also at Green Bay. A. L. Reiner, superintendent at North Fond du Lac, has resigned and is succeeded by F. D. Pendell.

E. D. C. Chisholm succeeds W. A. Mather, promoted, as resident engineer of the Canadian Pacific, with office at Winnipeg, Man.

J. H. Peyton has been appointed chief engineer of construction in the newly organized Construction Department of the Louisville & Nashville. H. C. Williams, assistant engineer of construction, has been appointed assistant chief engineer of construction, and W. E. Smith, assistant superintendent at Birmingham, Ala., has been appointed superintendent of construction.

M. V. Hynes, division engineer of the Cincinnati, Hamilton & Dayton, at Dayton, O., has been appointed engineer maintenance of way with office at Cincinnati, O. F. H. Alfred, who formerly had charge of maintenance, has resigned to accept service with another company. J. F. White, division engineer at Indianapolis, has been transferred to Dayton, to succeed Mr. Hynes. H. A. Cassil has been appointed division engineer at Indianapolis, Ind., succeeding Mr. White.

J. W. Orrock, assistant engineer of the Canadian Pacific at Montreal, Que., has been appointed division engineer with office at North Bay, Ont., succeeding Frank Taylor, transferred to Montreal. C. R. Brown, division engineer at

J. G. Shillinger, Chief Engineer, Rutland R. R.

Montreal, has been appointed principal assistant engineer with office at Montreal.

F. P. Sisson succeeds T. T. Irving, promoted as resident engineer of the Grand Trunk at Detroit, Mich.

Walter T. Krausch has been appointed engineer of buildings of the Chicago, Burlington & Quincy. He will be located at Chicago.

A. C. Mackenzie, formerly assistant engineer of the Canadian Pacific, has been appointed engineer maintenance of way of the Eastern Lines. His offices will be at Montreal, Que.

J. G. Shillinger has been appointed chief engineer of the Rutland vice J. C. Irwin, resigned. Mr. Shillinger formerly was engineer maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis.

E. G. Hewson has been appointed resident engineer of the Grand Trunk with offices at Toronto, Ont., vice C. W. Power, resigned.

J. E. Willoughby, engineer of construction of the Louisville, Nashville, has resigned to accept a position in Hayti.

McGregor Bros., Rumford, Me., have been awarded the contract for building a railroad between Oquossoc and Kennebago for the Rangeley Lakes & Megantic, a Maine Central line. The work covers about 11 miles.

With The Manufacturers

RAILWAY TELEPHONE ACCESSORIES.

The Automatic Electric Co., Chicago, after much experimentation has made special adaptation of its line of telephone accessories to the need of the railways which are equipped with telephone dispatching systems.

The apparatus manufactured by this company, which is especially available for railway use consists of waterproof receiver and desk set cords, condensors, metal mouth pieces, insulated wire, telephone cables, intercommunicating systems, and other telephone supplies.

The cords are made of silk, and are so treated as to render them waterproof. It is stated that these cords have been placed by one railway to the difficult tests of holding it under running hot water for a period of five minutes, and then connecting it to a 290 volt circuit. The test was successful in that the cord showed no leak. On account of its moisture proof feature this cord is recommended for unusual moisture conditions.

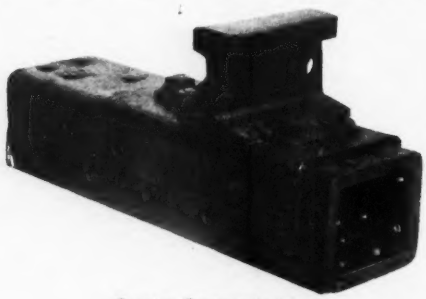
The condensers are guaranteed to have an insulation resistance of 500 meghoms and to have passed a breakdown test of 500 volts. Samples have actually been tested to 3,200 megohms insulation resistance, and did not break down at an alternating current pressure of 1,000 volts. It is stated that these condensers are sold at prices considerably lower than others which will stand this test.

The metal telephone mouthpieces manufactured by this company will fit the standard desk or wall phone. They are made with a steel shell which is covered with a rubber composition. This rubber covering will not break or chip off the metal base. In fact, it has been found to be almost everlasting.

GEARON COMPOSITE TIE.

The Gearon composite steel tie was demonstrated at the fourth annual exhibition held by the National Railway Appliances Association at the Chicago Coliseum last month. It was commented on favorably by many roadmasters, track supervisors and track foremen.

This tie is of sheet steel rolled into standard dimensions in length, width and depth to conform to standard requirements of ballast and rail bearing surface. The entire tie is made from a single sheet of metal. The weight and strength of the tie can be made to suit varying conditions by using different thicknesses of sheet, and by varying the number of folds. It is packed with a sheet of fireproof, waterproof fabric which is rolled with the steel sheet to form a tie of alternate plies of steel and fabric in a hollow laminated form. When the tie is rolled, the top, bottom and sides are drilled and riveted. The rivets hold the laminations in rigid contact, reinforce the bearing strength of the tie and bring the steel sheet and fabric sheet into perfect co-operation, making the tie practically one composite body of great strength, and also with the necessary resiliency.



Gearon Composite Tie.

The sheet of packing is rolled between the plies of the sheet of steel throughout the entire length of both sheets, thereby eliminating metal contact vibration. The steel sheet and fabric sheet are compressed into form over a steel mandrel under powerful pressure which makes the contacting surfaces between the plies of steel and fabric practically impervious to air or water, thereby preserving the inner plies from rust or decay. Being in a square truss form the tie can be drilled or sawed through any of its sides, to engage rail or girder fastenings, without materially affecting its strength. Only a little over one-third of the steel in the tie is exposed to corrosion and this exposed surface can be treated by any rustproof coating or paint either before rolling, after rolling, or after it is in the track in service. It has been estimated by competent metallurgists that this tie will with one rustproof treatment, endure service wear and resist corrosion for more than twenty-five years.

When wear and corrosion have rendered it unsafe or unserviceable it will be worth one-third its original cost in scrap steel.

The inventor of this tie claims that it will retain ballast and keep its ballast bearing better than any kind of wooden tie; rails, braces, plates and fastenings used will, because of the resilient bearing, give better and longer service than when used on a wooden tie; the heaviest locomotives and motors in service today could haul a train of the heaviest steel construction over a road laid with these ties at a speed that has never been attained before, in perfect safety.

The tie herein described is being put on the market by John Gearon, Sr., 159 E. Ohio street, Chicago.

AN EFFICIENT TIE PLATE.

The Sellers Manufacturing Co., McCormick Building, Chicago, exhibited at the Railway Appliance Association Exhibit last month a tie and tie plate, an illustration of which is shown herewith.

This plate and tie was recently taken out of track after 10½ years of continuous service. It was on a four degree curve in the main line of a Northern road, having a heavy iron ore traffic. The photograph shows that the tie plate has not moved from its original position and has furnished excellent protection to the tie. This tie plate is designed to imbed itself into the tie with minimum injury to the wood fibres, yet with a bond sufficient to prevent the rail from spreading.

Sellers Tie Plate, After 10½ Years' Service.

The Sellers plate is rolled from new 600 pound wrought iron billets, and is the only wrought iron tie plate on the market. It is claimed that wrought iron does not corrode and rust as quickly as rolled steel.

ANNUAL MEETING, NATIONAL RAILWAY APPLIANCES ASSOCIATION.

The annual meeting of the National Appliances Association was held March 19, President Belknap in the chair. The treasurer's report showed receipts from booth spaces this year to be $23,957, and from membership fees, $4,575; total, $28,532. Disbursements to date, $19,710, with some bills still unpaid. There will be a surplus probably equal to that of previous years. The assets, leaving out this year's probable surplus, are $6,728, of which $5,567 is in cash.

The president then read his annual report, which briefly was as follows:

"At the annual meeting last year the following board of directors and officers was elected: Robert E. Belknap, A. P. Van Schaick, John N. Reynolds, T. R. Wyles, Geo. C. Isbester, N. M. Hench, S. W. Hayes, C. W. Kelly, H. M. Sperry, together with Mr. T. W Snow as honorary director

"At the first meeting Mr. John Reynolds as secretary resigned and in his place your board, in accordance with the new constitution and by-laws, appointed the secretary, Bruce V. Crandall.

"During the year we have accomplished certain things that to us seemed very important: 1st. The incorporation of our association. 2nd. The adoption in connection with this action by letter-ballot of a new constitution and by-laws. These new by-laws were prepared with the help of the attorney of the association, Victor Elting. 3rd. As it was found impossible this year to rent the fixtures heretofore used, the board bought fixtures which now belong to the association and by economical management has accomplished this with only a very slight additional cost to each member.

"This year we had presented to us the question of continuing in the Coliseum with the balcony, or of going elsewhere entirely or of taking on a new building. As there was considerable objection voiced by the balcony exhibitors last year your board finally decided to make the exhibition in the Coliseum and the First Regiment Armory, leaving out the balcony, somewhat as has been done with the different automobile shows, only in their cases the balconies are also utilized.

"To give you an idea of the demand for space it may be noted that last year where we occupied only some 36,000 square feet of exhibit space we are this year presenting the show with over 50,000 square feet and we had to turn down from ten to twenty applications during the last month from representative manufacturing concerns.

"With regard to the allotment of space it might be well to say that the allotments were entirely awarded by your board of directors at a meeting of the full board November 8th. Where possibly some of our exhibitors believe that they did not get all that they were entitled to, the board fully believes that they have made the different allotments as fair-mindedly as possible taking into consideration the character of the exhibits and the needs of the different exhibitors together with the terms of membership and particularly conscious of the debt to those companies that originally put this show on its present footing. To give you an idea of the work that is necessary to accomplish this exhibition you will be interested in knowing that your board of directors have met three times and the executive committee have met 22 times during the year.

"With regard to the financial standing of our association, I would refer you to the report of our treasurer, which shows that the standing of our association is certainly in comfortable condition.

"In conclusion, it has been very gratifying to be able to present not only this report, but as the head of your association to note the large interest that the different railroad men of this country have taken in our annual exhibition of railway appliances. Our secretary this year has received many letters of praise from the different railroad men of the work here, particularly with regard to its educational value to the men of all their departments. Not only that, but many of the railroad officials have sent letter after letter requesting passes for different ones of their lines so that they might come here and view for themselves the material of our exhibits.

"It is also very pleasant to mention the feeling of appreciation that I have and that you as an association should have for the different members of your present board of directors who without stint have given up their valuable time to the work necessary, and again in their behalf and myself personally I certainly wish to thank each exhibitor for the hearty support and co-operation that they have given to us in every way, broad-mindedly and most liberally."

The committee on nominations, following the plan given in the president's report, offered the following ticket:

President, A. P. Van Schaick, Lackawanna Steel Co.

Vice-president, T. R. Wyles, Detroit Graphite Co.

Treasurer, John W. Reynolds, Railway Age Gazette.

Directors, one year—L. R. Ashurst, Wharton Switch Co.; Walter H. Baldwin, Adams & Westlake. Two years—C. W. Kelly, Fairbanks, Morse & Co.; N. M. Hench, Carnegie Steel Co.. Three years—H. M. Sperry, Gen'l Railway Signal Co.; P. W. Moore, P. & M. Co

These were unanimously elected with the approval of the board.

With a unanimous and hearty vote of thanks to officers and directors, the meeting then adjourned.

At a meeting of the board of directors on March 22, Bruce V. Crandall was re-elected secretary.

FAIRMONT MOTOR CAR.

A new engine is being manufactured to equip hand cars for use as motor cars which fills all requirements. It is reversible, runs the car either way without turning car around and will pull 5,000 pounds (2½ tons) on a push car trailed behind. This equipment has been put on over 300 hand cars which are being used on the northern roads. These cars were used every day through the winter when the thermometer registered 40 to 46 degrees below zero.

The engine generates ample power to pull great loads and when applied to a speedier car, will propel it as fast as any car built.

The design is neat and compact. Every part is well made and interchangeable. The engine is a horizontal engine with very little vibration. There are but three moving parts to lubricate, and it will run continuously without heating. There are no valves, push rods, gears, eccentrics or other complicated parts.

The connecting rod boxes and heavier bearings are very long and are easily removable and interchangeable. The entire engine is self contained and no piping or gearing is necessary. A belt drive is used for transmitting the power. The engine rests on a sliding base, and the belt can be tightened to any desired degree.

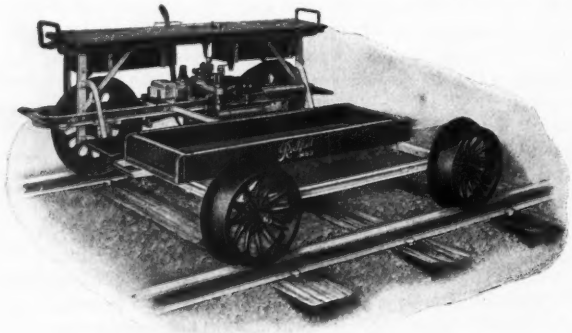
The Chicago, Milwaukee & St. Paul has fully equipped the Chicago and Milwaukee division (one of the most important of its road) with these cars.

Because of being so simple, compact, easy to attach, and so successful in every test the Fairmont engine for hand cars is finding favor with many railways, roadmasters and section men. Seventeen railways have these cars in use on their sections. The Fairmont Engine Co., Fairmont, Minn., is manufacturing and marketing the engine described above.

IMPROVEMENTS IN ROCKFORD MOTOR CARS.

The manufacturer of the Rockford railway motor car has been putting out these cars equipped with high tension magnetos for several months and finds that the demand for cars with magneto ignition is much greater than that for battery ignition equipment and is constantly increasing.

The application of the magneto to the car permits the elimination of dry cell batteries, spark coil, and timer; and the whole ignition system is compacted into one unit. The magneto used is of the high tension type which is operated by a double throw cam on the cam shaft of the engine. This magneto is extremely simple in design and operation and highly efficient. It does not require the use of either a switch or a timer and has no electrical contacts. It requires no adjustments—in fact, has no parts which can be adjusted—and produces a very hot spark which is quite independent of the speed of the engine. The strength of the spark, and its consequent ignition value, is the same at any speed at which the car may be running. The magneto is very durable and should give long service. It has, in fact, only two parts which can be said to be subject to wear at all. These are hardened steel blocks, easily replacable at very slight cost, and even the wear upon these blocks is very slow. On test one of the magnetos was run five thousand miles on a No. 4 car without showing any appreciable amount of wear on any parts. The working parts of the magneto are entirely enclosed, making the whole ignition system both dirt and waterproof. The space taken up by the magneto is approximately 10x6x3 inches and its weight 12 pounds. The only wires required with it are those running to the spark plugs, and it will operate with equal effectiveness in either direction—a fact which permits it to be used on the Rockford reversible motor without any reversing switch at all.



Rockford No. 3 Motor Car.

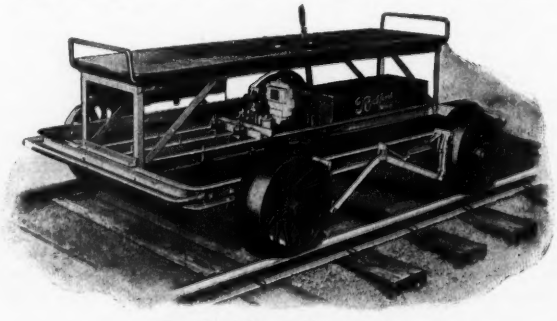
Magneto ignition as applied to these cars presents points of advantage over the battery system. It is more simple and consequently less likely to give trouble. The dry cell battery, spark coil, timer and wiring are dispensed with. Weak batteries, poorly adjusted spark coils and timer troubles will never vex the user of the magneto-equipped car, nor will he ever be compelled to puzzle over complicated wiring diagrams or hunt through a maze of wires to find the origin of his ignition troubles.

In the matter of necessary repairs and replacements and the upkeep of the car the magneto is a cost reducer. The necessity for the constant buying of dry cells for battery replacements no longer exists and the usual item of spark coil repairs is also eliminated. The magneto itself will require almost no repairs, under any ordinary service conditions, although it is easily accessible to the operator of the car at all times.

As a result of constant experimenting a number of additional improvements have been made in Rockford cars. Among these is the application of gears to the driving of the cam shaft on the engine, eliminating the possibility of chain troubles. These cars, having the engine direct connected to the drive axle of the car, have never used chains for any purpose except for driving the cam shaft and the substitution of gears and shaft for this drive consequently does away with all necessity for sprockets and chains.

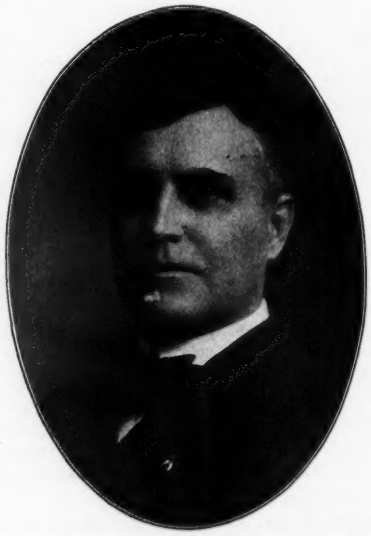
The cam shaft of the engines is now driven by spiral gears and an intermediate shaft. The gears and shaft are entirely enclosed and run in oil, insuring lubrication and protection from water and dirt. This drive is more positive and reliable than a chain drive and is also more durable. There is no possibility of the car getting out of time because of wear, as happens in connection with the use of chain and sprockets, and little possibility of breakage.

The gear driven cam shaft has received a thorough test and is in actual service on a large number of cars at the present time, and it has been found to be entirely satisfactory. On the older types of Rockford cars some trouble in connection with chain driven cam shafts was experienced, due to the fact that the distance between centers was considerable, and it was absolutely necessary that the chain remain tight. Wear upon the chain and its consequent elongation resulted in throwing the car slightly out of time when run in a reverse direction and thus prevented the engine from operating at its maximum efficiency. With the gear driven cam shaft this cannot happen and more service can be gotten from the car without replacements.



Rockford No. 4 Motor Car.

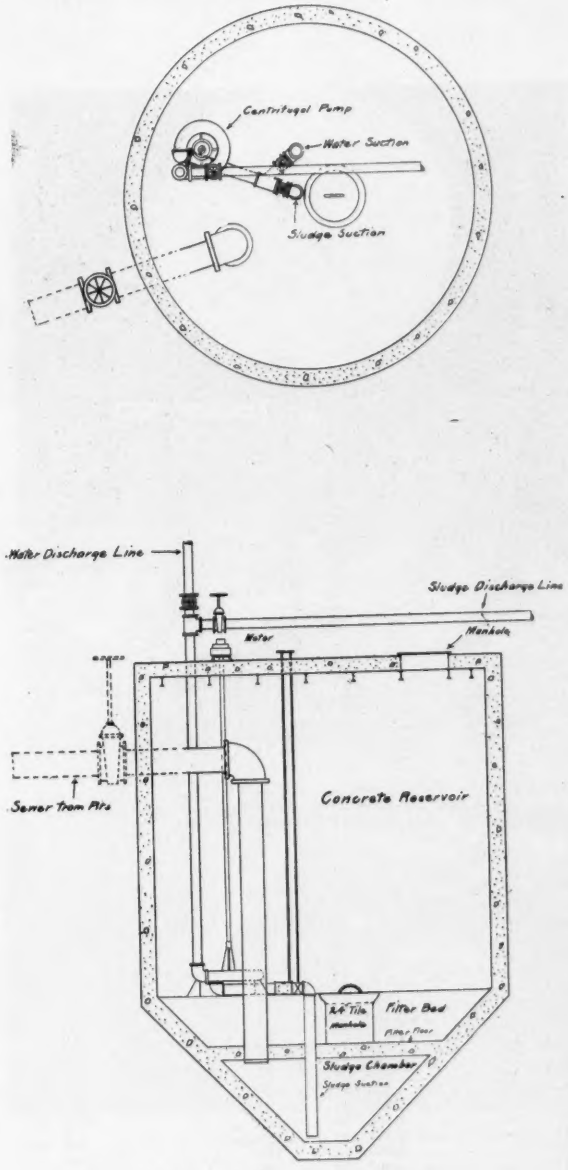
Material improvements have also been made in other parts of the car. The Chicago Pneumatic Tool Co., Fisher



Charles E. Walker, Manager Railroad Department, Chicago Pneumatic Tool Co.

Building, Chicago, manufactures the Rockford car. It is sold on easy terms where such arrangements are desired by the purchaser.

C. E. Walker is the popular and widely known manager of the railway department of this company. He was employed first at the National Locomotive Works, Connellsville, Pa., and left this company in 1883, to accept the position of roundhouse foreman with the C. H. & D., at Cincinnati, O. In 1885 he became general foreman for the Cincinnati Southern at Ludlow, Ky., leaving this position to become a locomotive engineer on the C. N. O. & T. P. In 1888 he again went with the C. H. & D., as general foreman at Lima, O., and was promoted in 1889 to master mechanic at Cincinnati, O. He was appointed superintendent of motive power of the T., St. L. & W., at Frankfort, Ind., in 1892, leaving this position in 1895 to become master mechanic of the B. & O. Southwestern at Washington, Ind. In 1899 he accepted a position with the Chicago Pneumatic Tool Company, and has made many friends during his connection with this company.



Water Filtering and Recovery System.

BOILER WASHING WATER RECOVERY SYSTEM.

In connection with the installation of a boiler washing system at Richmond, Va., on the Richmond, Fredericsburg & Potomac R. R., the Horace L. Winslow Co., of Chicago, included in the equipment a noteworthy water recovery system.

This device is shown in the accompanying drawing. It consists of a concrete reservoir placed under ground at a convenient location near the roundhouse. The concrete tank is 17 feet in diameter and 24 feet deep, and is connected with the drain pipes to which all the pits of the roundhouse are connected. By this means all the water used in washing out a locomotive is saved, filtered and returned to service, thus affecting great economy in the matter of water used. This size is of capacity sufficient to handle the water for the washing of two boilers simultaneously.

A centrifugal pump located on a vertical shaft furnishes the means for returning the water and for disposing of the sludge. No difficulty has been experienced in this method. The piping arrangement is very clear in the drawing.

A LIQUID WEED KILLER.

Atlas "A" is a chemical for destroying the most tenacious weed growth—top, root and seed. When the vegetation has been treated with it, no re-growth will occur immediately from the stems otherwise left in the earth. The results are more permanent and economical than any known method of "top plant" destruction.

Wood which has been immersed in a solution in this preservative, resists fire, it is claimed, in the ratio of four to one, as compared with untreated wood. The fibres of the ties are hardened, and decay is reduced where soft or spongy parts exist.

Vegetation existing on the track causes decay of ties and rusting of the rails and fastenings, due to the natural moisture held in contact thereby.

This weed killer is a highly concentrated chemical liquid, which is diluted with water to act as a distributor, and applied to the surface by a suitable sprinkling device. The particular kind of a sprinkling device, and dilution with water, can be arranged to suit the various natural conditions and amount of work to be accomplished with respect to economy and convenience.

The first treatment of a given area is intended to deal with the long-established growth; and is necessarily heavier in quantity and cost than the subsequent treatments which deal only with incidental seedling growths. The effects of the subsequent applications are also cumulative, so that each year the quantities can be reduced and the surfaces rendered more sterile. An average, therefore, over five years' use is the proper method of figuring costs.

As a general working basis for the usual vigorous growth of vegetation in the first year, it is necessary to use ten gallons of Atlas "A" for each one-foot width of track one mile long. This quantity will be found sufficient for the usual growth found in ordinary circumstances, but in large work, where it is necessary to study special conditions, the quantity may be governed to give the greatest economy or efficiency. Conditions which effect the quantities are the nature of the ballast and soil, whether it consists of clay, sand, or heavy loam, the character of the vegetation, and the growing season.

The quantities above outlined are for the first year's use. It is possible to effect a progressive reduction of quantities in the subsequent years after eradication of old-established growth. This reduction can be best outlined after the first year's effects are carefully noted. It can usually be found possible to effect a reduction of 60 per cent by the fifth year.

One dressing in the first year will, it is claimed, be sufficient to prevent re-establishment of growth for six months. A degree of re-growth may be expected towards the end of this period where vigorous vegetation exists. The effects of the first application, however, are retained, and will render the second treatment easier of accomplishment and more nearly perfect than the first.

Atlas "A" may be applied any time during the growing season. Considering the greatest efficiency and appearances, however, it is best to destroy the vegetation before it has reached the stage where it will remain standing after being killed. Atlas "A" causes the vegetation to wither and shrivel up, but the stalks, before they rot, would be unsightly.

The application should invariably be made in fine weather, as far as possible after a short dry spell. Plants quickly absorb the moisture after a dry spell when they are thirsty. On no account should the treatment be carried out immediately after a heavy rainfall.

In extensive work a large tank car of five to eight thousand gallons capacity is the most desirable apparatus for spraying the chemical. The discharge pipe under the tank can be fitted with a spraying device which can be attached or detached without injury to the car, and held for use in the future. An air hose from the engine, attached to the manhole, can be used for agitating the liquid and, after mixing, for pressure to force the liquid from the sprayer at an equal degree independently of the gravity pressure of the liquid. This equipment is the most efficient for speed, even application, and ability to penetrate, owing to the driving pressure of the solution.

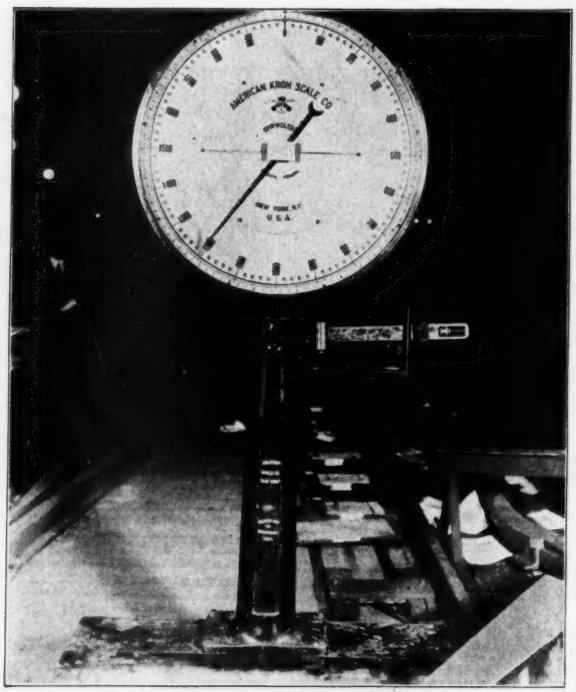
Atlas "A" preservative is marketed by the Atlas "A" Preservative Co. of America, 95-97 Liberty street, New York. This preservative has been on the market in this country for only two years, but has been highly commended by a number of users. In foreign countries this chemical has been used for a long time and has demonstrated its economy and efficiency.

VOTING CONTEST, INDIANAPOLIS SWITCH & FROG CO.

The guessing contest of the Indianapolis Switch & Frog Co., at its booth in the Armory, at the Exhibit of Railway Appliances in Chicago, attracted a great deal of attention. The object of the contest was to demonstrate the substantial weight of the R. N. R. solid manganese frog. A gilded frog was on exhibition at the booth and the voters, after examining it, guessed at its weight and were given a numbered coupon on which the weight was registered. Only accredited railway men were entitled to a vote, and in case any other persons voted, their guesses are to be discarded in making the awards. The watch fobs are to be awarded as soon as possible. There will be a little delay, however, as the initials of each person are to be put on his fob.

The frog was publicly weighed at the close of the convention and the exact weight is 1206 lbs., 0 ozs. Following is a list of the guesses made by each coupon holder:

No.	Lbs.	Oz.	No.	Lbs.	Oz.
1	1,560	10	23	1,835	00
2	2,348	07	24	1,785	00
3	1,325	12	25	1,853	00
4	1,297	09	26	1,763	01½
5	1,550	00	27	2,260	00
6	1,425	09	28	1,961	00
7	1,509	08	29	1,999	00
8	1,301	06	30	1,800	00
9	1,900	00	31	3,000	00
10	1,400	00	32	2,137	10
11	1,700	00	33	1,497	08
12	4,500	00	34	1,317	00
13	2,247	00	35	1,091	00
14	2,417	04	36	920	00
15	1,650	00	37	1,400	00
16	1,800	00	38	900	00
17	750	00	39	1,025	00
18	1,250	00	40	1,000	00
19	5,400	00	41	1,006	00
20	6,230	00	42	970	00
21	850	00	43	1,467	00
22	1,912	00	44	1,985	00
45	877	13	105	1,201	08
46	1,090	00	109	1,008	00
47	1,300	00	110	1,320	00
48	993	00	111	2,400	00
49	1,501	00	112	2,450	00
50	1,250	00	113	1,873	00
51	1,000	00	114	1,265	13
52	700	00	115	1,200	00
53	2,100	00	116	1,217	10
54	927	00	117	3,100	06
55	1,014	06½	118	1,313	13
56	1,579	00	119	3,415	15
57	1,613	12	120	3,600	00
58	1,758	12	121	1,750	00
59	2,700	00	122	1,150	00
60	1,270	00	123	1,278	08
61	1,376	11	124	2,500	00
62	850	00	125	1,563	07
63	1,460	09	126	1,140	14
64	1,175	00	127	1,516	00
65	1,467	07	128	980	00
66	1,570	00	129	800	00
67	2,389	00	130	750	00
68	785	04	131	1,201	02
69	695	08	132	800	00
70	710	00	133	897	09
71	3,000	00	134	1,281	00
72	1,385	00	135	1,650	00
73	1,100	00	136	2,330	00
74	1,787	00	137	1,050	00
75	2,100	00	138	1,000	00
76	913	13	139	1,200	10
77	1,299	09	140	1,210	00
78	1,455	12	141	1,450	00
79	1,413	13	142	1,800	00
80	2,100	00	143	1,200	00
81	2,700	00	144	975	60
82	2,000	00	145	900	00



Weighing the Indianapolis Switch & Frog Co.'s "Golden Frog" on a Spencer-Otis Co's. Kron Scale. Decision of the Weight Guessing Contest.

No.	Lbs.	Oz.	No.	Lbs.	Oz.
83	1,075	00	146	817	07
84	700	00	147	1,999	01
85	1,325	00	148	3,500	00
86	762	08	149	1,950	10
87	754	12	150	1,400	75
88	1,875	00	151	1,575	00
89	1,200	00	152	700	00
90	1,149	14	153	2,500	00
91	1,100	00	154	750	05
92	1,780	00	155	1,195	00
93	1,700	00	156	951	05
94	1,379	00	157	1,091	07
95	2,323	00	158	1,236	08
96	588	10	159	1,010	00
97	610	00	160	1,550	00
98	1,150	00	161	910	01
99	990	00	162	3,300	00
100	2,100	00	163	1,470	00
101	1,125	00	164	940	00
102	1,300	00	165	1,080	00
103	1,500	00	166	1,456	00
104	1,800	00	167	1,450	00
105	4,395	00	168	1,875	00
106	1,857	00	169	1,435	00
107	823	04	170	3,300	00

An Interior View of the Armory at the Exhibit of Railway Appliances in March.

No.	Lbs.	Oz.
171	4,000	00
172	810	00
173	1,600	00
174	820	10
175	4,320	00
176	2,445	00
177	1,298	08
178	3,890	00
179	800	00
180	447	00
181	000	00
182	3,500	00
183	1,463	00
184	4,784	13
185	4,923	13
186	5,113	15
187	873	14
188	5,975	12
189	2,350	00
190	982	07
191	933	03
192	900	00
193	1,061	00
194	1,281	10
195	613	08
196	1,350	00
197	2,200	60
198	933	07
199	2,160	00
200	1,485	06
201	1,218	00
202	1,860	00
203	1,867	06
204	936	04
205	2,200	00
206	3,240	00
207	1,083	00
208	1,456	10
209	1,333	00
210	981	00
211	1,500	00
212	2,360	00
213	2,500	00
214	1,680	00
215	2,950	00
216	1,143	00
217	1,150	00
218	1,113	00
219	1,100	00
220	900	00
221	850	00
222	930	00
223	1,001	09
224	678	00
225	1,416	08
226	1,468	00
227	2,313	13
228	3,950	00
229	1,400	00
230	1,376	04
231	10,000	00
232	4,200	00
233	2,700	00
234	2,149	00
235	1,690	00
236	1,550	00
237	720	00
238	850	00
239	805	00
240	1,215	02
241	2,863	00
242	1,500	00
243	1,250	00
244	2,500	00
245	1,385	00
246	1,400	00
247	2,385	00
248	880	00
249	605	05
250	1,118	00
251	1,250	00
252	2,252	02
253	1,875	12
254	1,900	00
255	1,847	00
256	1,290	00
257	1,101	09
258	2,000	00
259	1,265	00
260	655	00
261	675	00
262	550	00
263	1,075	12
264	0000	00
265	4,000	00
266	1,980	00
267	1,200	00
268	1,320	00
269	1,250	00
270	870	00
271	4,950	13
272	1,285	12
273	1,530	00
274	1,800	00
275	1,640	00
276	1,225	07
277	150	00
278	1,560	06
279	1,395	09
280	10,700	10
281	1,368	00
282	550	00
283	1,743	12
284	2,000	00
285	1,860	00
286	1,925	00
287	1,115	00
288	3,200	00
289	3,800	00
290	1,600	00
291	1,792	06
292	1,600	00
293	1,860	00
294	1,576	00
295	1,695	00
296	1,200	00
297	1,489	06
298	533	10
299	1,200	00
300	1,102	03
301	1,500	00
302	1,700	00
303	2,765	04
304	1,900	02
305	1,150	00
306	955	00
307	948	00
308	965	10
309	600	00
310	1,156	13
311	1,250	00
312	1,325	00
313	3,680	00
314	1,325	00
315	1,405	00
316	1,663	10
317	2,295	00
318	1,650	00
319	732	13
320	899	10
321	1,035	00
322	950	00
323	3,320	00
324	2,883	10
325	937	06
326	2,295	00
327	1,293	10
328	1,650	00
329	1,100	00
330	1,395	08
331	3,000	00
332	1,365	00
333	625	00
334	1,650	00
335	1,255	00
336	1,400	00
337	1,325	00
338	900	00
339	2,200	00
340	7,580	08
341	1,002	00
342	3,510	00
343	1,375	08
344	1,000	00
345	975	07
346	3,700	00
347	987	12
348	1,480	00
349	0 000	00
350	1,445	00
351	0,000	00
352	2,100	00
353	2,190	00
354	1,300	00
355	2,600	00
356	3,250	10
357	1,350	00
358	1,150	00
359	1,400	50
360	900	00
361	1,800	00
362	1,092	00
363	1,200	00
364	1,950	00
365	1,259	00
366	1,573	03½
367	825	00
368	1,150	00
369	1,440	00
370	1,565	00
371	3,210	00½
372	1,685	00
373	1,697	00
374	1,987	00
375	1,327	00
376	1,040	00
377	985	00
378	1,350	02
379	1,470	09
380	1,370	00
381	1,500	00
382	1,275	00
383	1,100	00
384	2,485	00
385	1,392	08
386	1,363	02
387	1,150	00
388	1,337	08
389	1,980	10
390	1,600	00
391	1,765	08
392	1,843	00
392	1,280	00
394	3,940	00
395	1,186	00
396	1,240	10
397	2,007	10
398	1,260	00
399	1,120	13
400	1,150	08
401	999	01
402	997	13
403	1,458	00
404	1,894	07
405	1,250	00
406	1,222	14¾
407	1,013	03¾
408	1,248	07
409	2,028	00
410	3,325	00
411	3,200	00
412	940	00
413	1,334	07
414	1,147	05
415	1,125	11½
416	1,210	00
417	1,200	00
418	1,350	06
419	1,300	05
420	720	00
421	1,347	00
422	936	00
423	1,472	10
424	1,000	00
425	750	00
426	3,250	00
427	1,652	07
428	1,466	00
429	1,323	13
430	1,780	00
431	1,420	00
432	1,185	10
433	3,550	00
434	2,550	00
435	1,297	12
436	1,715	00
437	830	00
438	1,131	07
439	1,350	00
440	425	06
441	1,022	00
442	1,058	00
443	999	00
444	1,203	02
445	2,760	00
446	2,849	00
447	1,500	00
448	1,875	00
449	5,000	00
450	750	00
451	1,782	06
452	1,183	08
453	1,156	08
454	1,335	00
455	1,011	00
456	632	00
457	4,600	00
458	1,756	00
459	1,483	00
460	1,540	00
461	1,063	00
462	1,264	00
463	1,460	00
464	1,187	05
465	1,700	00
466	2,367	04½
467	1,200	00
468	0,000	00
469	1,082	06
470	1,581	00
471	1,075	00
472	660	00
473	1,275	00
474	0000	00
475	1,550	00
476	1,165	00
477	1,210	00
478	1,185	00
479	1,152	08
480	1,185	00
481	1,110	06
482	1,113	13
483	1,192	00
484	1,195	15
485	953	00
486	1,044	03
487	1,175	00
488	1,460	00
489	2,175	00
490	2,800	00
491	1,200	00
492	1,250	00
493	1,323	00
494	1,941	02
495	2,000	05
496	1,223	08
497	1,123	00
498	1,375	00
499	1,313	00
500	1,327	00
501	852	00
502	1,226	02
503	1,229	00
504	2,676	13
505	2,225	00
506	2,487	00
507	1,250	00
508	900	00
509	1,472	00
510	1,110	00
511	1,350	05
512	3,705	10
513	1,293	00
514	1,500	00
515	1,080	03
516	1,100	06
517	3,300	00
518	995	00
519	1,058	00
520	1,150	00
521	1,080	00
522	850	00
523	1,050	00
524	987	10
525	1,210	00
526	1,800	00
527	1,500	00
528	1,550	00
529	1,725	00
530	4,400	00
531	1,250	00
532	1,991	06
533	2,587	00
534	1,283	00
535	1,526	03
536	1,899	00
537	1,213	13
538	1,333	13
539	1,422	07
540	1,420	07
541	1,620	00
542	2,750	00
543	2,175	06
544	2,200	00
545	1,021	00
546	1,600	00
547	8,100	00
548	978	14
549	1,190	10
550	1,224	08
551	1,530	05
552	1,046	08
553	1,440	00
554	1,351	00
555	1,850	00
556	1,675	00
557	930	00
558	810	13
559	1,540	00
560	1,833	07
561	875	00
562	1,375	00
563	1,645	09
564	1,520	00
565	2,500	00
566	848	00
567	975	00
568	1,382	08
569	1,420	04
570	1,024	00
571	1,400	00
572	642	13
573	1,725	00
574	2,100	00
575	2,384	10
576	1,790	00
577	1,675	00
578	1,375	00
579	1,937	08
580	712	08
581	1,650	00
582	4,025	00
583	960	05
584	1,870	04
585	1,783	00
586	1,850	00
587	2,750	00
588	1,314	00
589	1,067	00
590	1,090	00
591	1,078	10
592	5,340	00
593	5,600	14
594	4,365	00
595	5,350	00
596	5,500	00
597	49,000	12
598	500,016	08
599	2,845	14
600	4,240	08
601	1,050	00
602	1,113	00
603	1,022	00
604	1,080	00
605	1,234	12
606	1,500	09
607	1,500	00
608	1,618	00
609	978	08
610	6,975	10
611	6,790	00
612	761	00
613	800	12
614	1,650	00
615	4,450	00
616	4,678	00
617	4,200	00
618	0000	00
619	1,198	09
620	2,000	00
621	3,500	20
622	4,150	00
623	745	00
624	2,500	07
625	1,250	00
626	1,820	00

No.	Lbs.	Oz.
627	1,625	00
628	2,000	04
629	2,850	08
630	805	02
631	1,070	00
632	1,494	10
633	1,455	07
634	4,300	00
635	1,467	00
636	2,000	00
637	2,250	06
638	6,000	00
639	3,650	00
640	2,000	00
641	3,500	00
642	3,200	18
643	4,795	09
644	41,692	12
645	1,043	00
646	2,200	00
647	50,000	14
648	0000	00
649	0000	00
650	4,800	00
651	1,000	00
652	1,150	00
653	1,250	00
654	1,050	00
655	1,500	00
656	1,200	10
657	1,575	00
658	1,450	00
659	1,450	00
660	2,000	00
661	950	00
662	1,875	00
663	2,600	09
664	1,990	00
665	850	00
666	1,291	02
667	1,080	00
668	1,000	00
669	490	00
670	1,052	00
671	750	00
672	1,650	00
673	1,780	00
674	0000	00
675	3,850	04
676	1,472	08
677	1,313	00
678	950	00
679	3,500	00
680	3,275	05
681	2,900	13
682	1,179	09
683	1,325	08
684	3,256	10
685	1,950	00
686	2,300	00
687	1,550	00
688	1,474	37
689	1,650	00
690	2,000	00
691	4,832	00
692	0000	00
693	1,300	00
694	945	00
695	1,192	04
696	0000	00
697	2,868	09
698	2,340	00
699	799	08
700	2,900	10
701	1,400	00
702	1,080	00
703	1,500	00
704	1,325	00
705	1,285	00
706	1,500	00
707	4,397	07
708	2,270	00
709	1,487	09
710	1,542	00
711	1,425	05
712	1,451	05
713	2,050	00
714	1,326	13
715	11,342	04
716	2,437	00
717	0000	00
718	2,436	09
719	918	11
720	1,265	09
721	1,326	10
722	725	00
723	2,200	00
724	1,326	00
725	1,420	00
726	4,250	00
727	3,500	50
728	675	00
729	1,685	08
730	2,250	05
731	3,150	00
732	1,713	13
733	1,562	00
734	1,669	00
735	1,600	10
736	2,300	00
737	1,985	00
738	1,800	00
739	1,054	00
740	1,120	00
741	1,360	00
742	1,235	00
743	1,475	00
744	1,496	04
745	0000	00
746	1,280	00
747	1,200	80
748	0000	00
749	1,501	00
750	1,750	00
751	1,500	06
752	1,299	04
753	8,000	00
754	1,725	00
755	1,034	08
756	750	00
757	4,500	00
758	3,200	00
759	875	00
760	1,350	00
761	1,360	00
762	1,127	08
763	1,440	00
764	2,350	00
765	1,500	00
766	6,000	00
767	879	09
768	1,250	00
769	1,435	00
770	3,500	00
771	1,365	08
772	1,419	12
773	1,015	00
774	961	00
775	875	00
776	951	00
777	2,250	00
778	1,450	00
779	1,368	09
780	1,862	00
781	1,048	11
782	850	00
783	687	00
784	986	12
785	847	07
786	825	00
787	1,847	00
788	1,700	90
789	2,100	00
790	1,550	00
791	1,375	00
792	1,650	00
793	1,625	00
794	2,250	00
795	0000	00
796	785	00
797	1,856	08
798	2,150	08
799	1,890	00
800	1,277	00
801	950	00
802	1,230	00
803	1,473	00
804	1,650	00
805	900	10
806	950	00
807	1,850	00
808	1,150	00
809	1,050	00
810	1,800	00
811	1,200	00
812	1,400	00
813	1,500	00
814	1,565	00
815	1,350	00
816	1,313	04
817	1,300	00
818	1,410	00
819	1,103	13
820	975	00
821	1,185	00
822	1,361	07
823	1,213	03
824	1,540	00
825	600	00
826	1,387	08
827	999	15
828	1,833	00
829	993	00
830	1,153	00
831	0000	00
832	1,227	00
833	1,157	10
834	1,045	10
835	968	00
836	800	00
837	850	00
838	3,800	00
839	1,360	00
840	1,313	00
841	725	00
842	2,100	03
843	1,886	06
844	1,244	00
845	1,956	08
846	1,875	00
847	0000	00
848	1,456	00
849	1,537	00
850	0000	00
851	1,175	00
852	850	08
853	1,252	06
854	1,450	00
855	1,285	00
856	1,309	08
857	1,678	01
858	1,155	10
859	2,895	00
860	1,150	05
861	1,090	00
862	950	00
863	400	00
864	685	08
865	4,760	00
866	3,750	00
867	1,168	00
868	1,073	06
869	1,087	04
870	1,860	01
871	1,953	11
872	895	10
873	1,567	00
874	1,865	00
875	1,200	00
876	1,650	00
877	1,795	00
878	2,960	00
879	2,640	00
880	820	00
881	979	12
882	1,955	00
883	2,346	07
884	3,250	00
885	1,175	00
886	3,180	00
887	4,123	00
888	1,196	10
889	2,700	00
890	1,250	00
891	1,313	00
892	1,123	00
893	0000	00
894	1,015	00
895	0000	00
896	960	00
897	5,000	00
898	1,030	00
899	1,133	00
900	0000	00
901	2,350	07
902	833	00
903	1,868	09
904	1,310	00
905	1,250	00
906	1,150	10
907	1,275	00
908	3,156	00
909	2,727	10
910	2,890	04
911	685	00
912	1,213	00
913	10,000	13
914	875	11
915	1,123	00
916	1,100	23
917	999	09
918	1,175	00
919	1,103	00
920	1,165	08
921	1,400	00
922	1,475	00

STRUCTURES.

The Atchison, Topeka & Santa Fe has appropriated $500,000 for a new office building at Galveston, Tex.

It is said that the officials of the Baltimore & Ohio have decided to construct a large round house and repair shop in the Canal Dover, O., yards this Spring.

The passenger station of the Baltimore & Ohio at Philadelphia, is to be connected with Market street by a covered walk, about 500 ft. long, thus affording passengers convenient access to the trains of the Philadelphia subway. The contract has been let.

It is reported that the Chicago, Milwaukee & Puget Sound will, in connection with the construction of the proposed spur from Sumner, Wash., construct a bridge over the Stuck river.

It is reported that surveys have been made and plans completed by the Chicago, Milwaukee and St. Paul for the construction of a new steel bridge to replace the present trestle on the south road out of Boone, Ia.

The Engineering Department of the Denver & Rio Grande is working on preliminary plans for the construction of viaducts over the tracks at Fourth South and Sixth South Sts., Denver, Colo.

The Kansas City Southern is to construct a six-stall roundhouse, a 90-ft. turntable, a machine shop, coaling plant, fuel oil plant, sandhouse and cinder pit, together with a yard having a capacity of about 700 cars at Watts, Okla.

The Lewisburg Bridge Co. has given a contract to the Pennsylvania Steel Co. for the steel work for a bridge to be built over the river at St. John street, Lewisburg, Pa. Estimated cost $65,000.

The Grand Trunk has given a contract to the Pennsylvania Steel Co. for 250 tons of structural steel for a single track bridge, over Back Cove at Portland, Me. The improvement will cost $70,000.

Permission has been granted to the Norfolk & Western to build a new pier at Lamberts Point, Va., north of pier No. 1, which is to be removed.

Work will be started at once on the construction of the New Northern Pacific shops at Yardley, near Spokane, Wash. This work will call for the expenditure of about $400,000. M. C. Murphy has the contract.

On the line now being built by the National Railways of Mexico from Durango west to Llano Grande, a bridge is being built over the Rio Chico. The structure will be 701 ft. long and 208 ft. above the river. In the center there is to be a 390 ft. cantilever span.

Industrial Notes

The Alexander Millburn Company of Baltimore, have recently equipped several locomotive cranes for the Maryland Steel Co. at Sparrows Point, Md., with their new steam acetylene generator, which utilizes the waste steam from the boiler, supplying a number of search lights, and allowing night work to be carried on satisfactorily. The C. N. O. & T. P. Ry. have also equipped one of their "Industrial" wrecking cranes with the same system. Mr. Frederick Maley, formerly with the Baldwin Locomotive Works, also the American Oxygen Co., has been appointed superintendent of the oxy-acetylene department of the Alexander Milburn Co., and will develop that firm's line of high and low pressure oxy-acetylene welding and cutting apparatus.

Mr. J. J. Cozzens, who has been appointed a representative of the Union Switch & Signal Co., was born at Huntingdon, Pa. He started signal work on the West Pennsylvania division of the Pennsylvania R. R. under the late Geo. D. Fowle, signal engineer, in 1886, where he was signal foreman for six years. He went with the Union Switch &

J. J. Cozzens, Representative Union Switch & Signal Co.

Signal Co. as foreman March 1, 1892, and with the New York Central as general signal foreman of Western division Nov. 1, 1893. In 1900 he became associated with the Standard Signal Co. as foreman and installed low pressure air plants on the Chicago & Western Indiana at 16th and Clark streets, Chicago, and at Suspension Bridge, N. Y., on the New York Central, and also represented this company at the Pan-American Exposition at Buffalo. He returned to the New York Central November 1, 1910, as assistant supervisor of signals of the Western division and was promoted to positions of supervisor, chief supervisor and assistant signal engineer of the Western division. He was chief engineer of the Kinsman Block System Co. from 1909 until they discontinued business, November, 1911, and has recently been appointed a representative of the Union Switch & Signal Co.

The W. K. Kenly Co., Peoples Gas Building, Chicago, Ill., has been appointed Chicago representative of the Concrete Form & Engine Co., which manufactures the well known Belle Isle power cars, and gasoline motors which can be installed on any standard speeder or section car.

Belle Isle power cars, manufactured by the Concrete Form & Engine Co., of Detroit, Mich., were included in the exhibit of the Kalamazoo Railway Supply Co., at the Railway

Show last month. These cars attracted much favorable comment and many of the users of Belle Isle outfits came around to become personally acquainted with Mr. W. D. Waugh, general manager of the company, who was in attendance at the show throughout the week. The company has recently issued a new 30-page catalog which explains in detail Belle Isle power cars and also shows how to install Belle Isle motors on velocipedes and section hand cars.

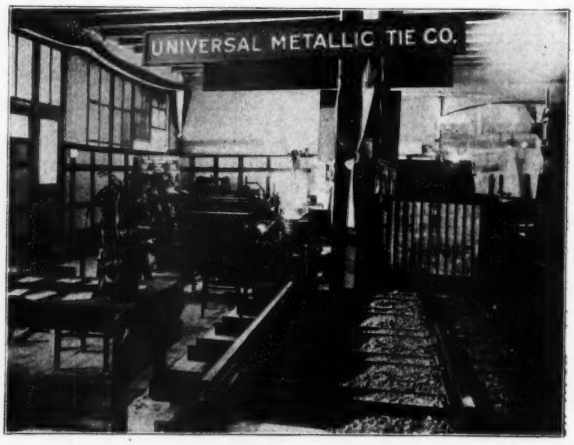
The Interstate Ry. Frog & Switch Co., Salisbury, N. C., has been incorporated by P. H. Thompson, F. M. Thompson, W. B. McCanless, D. L. Arey, E. C. Gregory and others. Capital stock, $30,000.

The Nachod Signal Co. announces that it has moved its executive offices from 929 Chestnut street to 214 South Twelfth Street, Philadelphia.

The Union Switch & Signal Co. has awarded a contract to the Cuthbert Bros. Co. for a three-story reinforced concrete office building to be erected in Swissvale, Pa., at a cost of $35,000.

The Hon. Van Vechten Veeder, Judge of the United States District Court, Eastern District of New York, fully sustained United States Patent No. 714,880, covering modern paint and varnish removers, owned by the Chadeloid Chemical Co. This decision was rendered in the suit of the Chadeloid Chemical Co. against the Daxe Varnish Co. The case was a contested one and arguments and re-arguments were heard and exhaustive briefs were submitted.

Mr. William Wilkes Young, purchasing agent of the Union Switch & Signal Co., died on Sunday January 21, 1912.



UNPOLISHED RAILS.

Sir: I note the Hon. Did-More Hearst's statement that the Twentieth Century Limited was "hurled into the Hudson by a rusty rail." Every railroad official knows that rust should never be allowed to accumulate on a rail, and every railroad that pretends to be properly equipped should have crews of rail polishers in active employment. Please call the attention of the interstate commerce commission to this culpable negligence. E. C. P.

—Line-o'-Type Column, Chicago Tribune.

RAILWAY CONSTRUCTION.

The Buffalo, Rochester & Pittsburgh has given contracts to the Miller Construction Co., Lock Haven, Pa., for grading and masonary work on a five-mile extension of the Jacksonville Mine line in Indiana county, Pa., and for revision work on the main line, near West Mosgrove, Pa.

The Canadian Northern is planning to relay 100 miles of track on its line between Ranier and Virginia, Minn.

The Canadian Northern Pacific will build from Kamloops, B. C., via Grand Prairie and Vernon to Kelowna, with a branch to Lumby, about 145 miles. The government has granted this company $35,000 a mile for the construction of a line on Vancouver Island.

The Canadian Pacific has bought 1,800 acres of land in East Kildon, a suburb of Winnipeg, Man., the site to be used for new yards.

The Chicago, Milwaukee & Puget Sound has let contracts and work is now under way building a line from Beverly, Wash., down the west side of the Columbia river, through White Bluffs to Hanford.

The Chatham Wallaceburg & Lake Erie contemplates extending its lines from Chatham to Blenheim.

The Clinton & Oklahoma Western is now being extended 30 miles west from Butler, Oklahoma.

The Denver & Rio Grande will expend about $15,000,000 within the next two years for betterments and improvements. The Denver shops are to be enlarged, the grades near Soldier Summit, Utah, at the continental divide, are to be reduced, and considerable double-track work will be carried out near that place.

Articles of incorporation have been filed with the secretary of state, Oklahoma City, Okla., by the Fort Smith & Wilburton. It is proposed to build a line from Akoma, Le Flore county, to Wilburton, in Latimer county, Okla., a distance of 50 miles. M. C. Burke, Fort Smith, Ark., is one of the promoters.

The Grand Trunk Pacific is understood to be planning to build a branch line from Napadeggan, the first divisional point west of Moncton, N. B., to Fredericton, a distance of 49 miles, to provide a more direct route to tide water at St. John, N. B., through a connection with the St. John Valley. It is stated that final decision with regard to this route has not been arrived at as yet.

The Jamestown Chautauqua & Lake Erie will replace about 32,000 ties in its roadbed this year.

The Kenilworth & Helper has been organized in Wyoming, and operates a four-mile line from Kenilworth Junction, Utah. The company has also been incorporated in Utah, with a capital stock of $250,000, and plans to build an extension northwest to Salt Lake City, about 100 miles, and an extension east to Vernal, in Uinta county, about 95 miles.

The Missouri, Oklahoma & Gulf has plans for a number of extensions in Oklahoma.

Preliminary legislation is before the City Council of Lorain, O., for the construction of a subway under the Baltimore & Ohio at East 28th St. The company has expressed its willingness to go ahead with the work. The subway will cost about $140,000, half of which will be paid by the city.

The Carlton & Coast contemplates building a six mile extension during the present year. V. C. Landon, superintendent, Carleton, Ore.

The Canadian Pacific has given a contract to W. A. Dutton, Winnipeg, Man., for grading 85 miles of the extension from Swift Current, Sask., northwest. A second contract has been given to W. A. Dutton for double tracking about 70 miles on the main line between Regina, Sask., and Chaplin.

The Cary North & South has given a contract to T. W. Ellis, Jr., Macon, Ga., to build from Cochran, Ga., north to Cary, 10 miles. Maximum grades 1 per cent., maximum curvature 6 degrees. D. B. Dunn, chief engineer, Macon, Ga.

The Chicago, Milwaukee & St. Paul is planning to spend $15,500,000 for grade reductions and double tracking work. Of this amount $10,000,000 will be used for the reduction of grades and double track on the Council Bluffs division. For improvements to lines and double track on the Hastings & Dakota division $5,500,000 will be spent.

The Chicago, Milwaukee & Puget Sound has given a contract to H. C. Henry, Seattle, Wash., to build an extension down the Columbia river from Cohasset to Hanford, and the work is now under way.

The East Texas Traction has been incorporated in Texas with $2,000,000 capital, and headquarters at Greenville, Tex. The plans call for building a line to connect Dallas, Tex., with Wolfe City, about 70 miles. The incorporators include J. F. Nichol, Dallas.

The Franklin & Abbeville has surveys in progress for a 35-mile extension from Milton through Maurice, Duson and Church Point to Eunice. The capital for construction has been secured and construction contracts will be let in about 60 days. Jules Godcheux, Godcheux Bldg., New Orleans, La., manager.

It is reported that officials of the A. T. & S. F. system have announced that the entire stretch between Richmond, Cal., and Stockton will be relayed with 90-pound steel.

Grading has been finished on 11 miles of the Bamberg, Ehrhardt & Waterboro under construction from Bamberg, S. C., south to Ehrhardt, 14 miles. The Ajax Construction Company, Bamberg, and W. C. Wolfe, Orangeburg, are the contractors.

A contract has been given to T. W. Ellis, Jr., Macon, Ga., for work on a 10-mile section of the Cary North & South from Cochran, Ga.

The Chicago, Joliet & Kansas City, has been given a charter in Illinois to build from Chicago, Ill., to Kirthsbury; also from Rockford to Peoria.

The Chicago, Milwaukee & St. Paul is understood to be planning a considerable amount of betterment work for the present season. For this work about $1,000,000 will be expended for grade revision and alignment on the Chicago & Council Bluffs Division and $1,500,000 for yard improvements at Chicago, Milwaukee and Seattle.

The Gulf, Texas & Western has secured the capital for the construction of a 25-mile extension from Jacksboro southeastward and will let contracts in about 90 days. Ben B. Cain, Dallas, Texas, vice president and general manager.

The Kansas City Terminal has awarded the contract for the construction of retaining walls, viaduct foundations etc., along its main line tracks between Grand Ave. and 18 St., Kansas City, to John J. O'Heron & Co. of Chicago, Ill.

Application has been made for a charter in Canada to build from Lindsay, Ont., north via Minden to Mountain Lake, the line to be called the Lindsay & Minden. A. H. Delemere, Minden, is a promoter.

On the Lexington & Eastern the North Fork extension has been extended to Haddix, Ky., six miles from Jackson.

The Louisville & Nashville is securing right of way for double tracking its line between Paris, Ky., and Winchester, Ky.

Recent Engineering and Maintenance of Way Patents

PATENTS.

CONCRETE CROSS TIE.

1,020,073—W. W. Frisholm, Leadville, Colo.

A concrete railway tie, consisting of a truss comprising a group of interlaced, longitudinally arranged bars, so arranged as to have an enlarged central portion by bending the center portion of their length outwardly to form with oppositely and similarly bent bars diamond shaped forms and having their ends converging to end portions smaller than their central portion and having rectangular shaped box portions extending from the smaller end portions. The central group of bars are extended to and connected to some portion of the end box shaped members, the tie being provided with a rail receiving plate arranged to secure rails in operative positions.

CONCRETE FENCE POST.

1,021,140—R. H. Forsyth, Curranville, Kan.

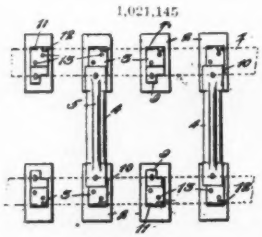
A fence post comprising in combination, a plastic body, a plurality of metal inserts molded in the body, each insert having its outer face flush with the outer face of the body and having a recess formed in its inner face and a transverse opening communicating with the recess. A clamping bar is used, with T-bolts having their heads disposed within the recesses of the inserts and their shanks engageable with the bar to clamp the bar to the post.

CROSS TIE.

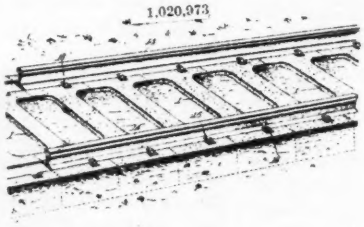
1,021,145—John Gorman, Peru, Ind.

Supporting plates in combination with railroad rails having portions of their outer edges bent upwardly to form lips and tongues for embracing the outer edge of the web of rails, the plates having their inner portions reduced in area where they project beyond the other edge of the webs and having a hole therein. The plates have one of their edges turned upwardly and the portions having these bent edges and the projecting portions are depressed in a lower plane than that of the rest of the plates. A plurality of sleepers is arranged to receive the plates, and means are provided for securing the plates to the sleepers, the tie-plates being adapted to rest on the depressed portions and span the intervening space between the rails and having a rib formed in their middle portions. The longitudinal edges are bent downwardly and arranged to be disposed between a pair of sleepers so that the same cannot move transversely inward, the tie-plates having holes in their outer portions ranged to correspond with holes in the projecting portions of the supporting plates when the same are in position. Means are provided in the holes for securing the rail and the plates to the sleeper.

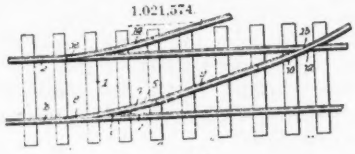
1,021,145



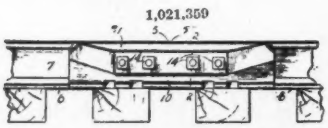
1,020,973



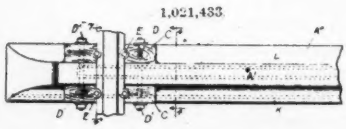
1,021,574



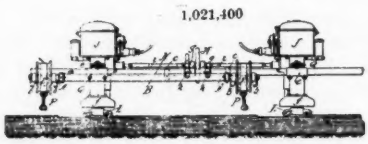
1,021,359



1,021,433



1,021,400



RAIL JOINT.

1,021,359—J. P. Dullurn, Wright, Minn.

A rail joint comprising angle bars fitted upon the inner and outer faces of rails and overlying their connection, the inner angle bar having an inwardly beveled upper portion upon which the heads of the rails are supported and a concaved portion outwardly thereof and extending from the inner face of the head to a point therebelow. The outer angle bar has a central enlargement provided with a rectilinear outer face and with side portions tapering inwardly toward the ends of the bar, the top portion of the bar being provided with a narrow horizontal tread surface and a beveled surface outwardly thereof to provide inclined end portions, the upper inner edge of the outer bar being formed with a shoulder receiving the under and outer portion of the head of each rail in supporting position. Fastening bolts connect the parts within the area of the rectilinear portion of the enlargement, the face of the inner bar having a semi-circular depression in an enlargement below the bolt heads.

ANTI-CREEPER.

1,021,388—D. F. Vaughan, Haddonfield, N. J.

An anti-creeper comprising jaws engaging the sides of the rail, and means for forcing the jaws toward each other and against the rail, the means including a spring exerting pressure in a direction longitudinally of the rail. A tongue rests against the side of the tie.

PORTABLE ADZING MACHINE.

1,021,400—Albert Collet, Paris, France.

The combination of a carriage adapted to run upon the rails of a railway having rollers thereon, a frame movable transversely upon the carriage, comprising transverse bars resting upon the rollers, cutters upon the end of the frame, adapted to groove a sleeper beneath it upon the road-bed, means provided for driving the cutters and for adjusting the height of the cutter.

CONCRETE TIE.

1,021,433—Andrew Stark, Chicago, Ill.

A concrete railway tie of inverted T-shape with bosses in the angle between the vertical and horizontal members at both sides of the vertical member at the rail crossings, the bosses forming at their upper sides ledges lower than the top of the vertical member; rail-supporting blocks are lodged on the ledges at opposite sides of the vertical member and extend higher than the top of the member. Transversely extending reinforcing rods are embedded in the horizontal member below the ledges.

RAIL CROSSING TO REPLACE FROGS.

1,021,574—H. D. Cummings, Hunt, N. Y.

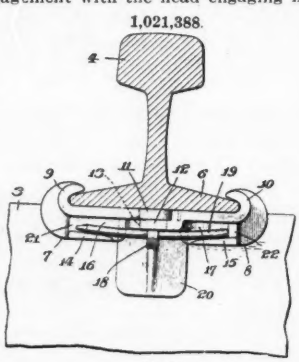
A crossover comprising a pair of rail members 9 and 19, the former arranged exteriorly of and the latter between the main track rails, a switch rail 4 arranged between the main track rails, registering with the rail 9 and cut away at one end to engage the inner side of the web and to overlap and engage the inner side of the base of one of the main track rails and flush with the head of the main track rail; a rail 14 positioned exteriorly of the main track rails, registering with the rail 19 and cut away at one end to provide a tongue extending on to the head of and further engaging the outer side of the web and the outer edge of and overlapping the inner side of the base of the other track rail, the tongue gradually increasing in height upwardly. A crossover rail is provided, registering with one end of the rail 9 and cut away intermediate its ends for the passage of that track rail upon which the head extends, the crossover rail having the web thereof of sufficient height to support its head above the head of that track rail which extends through the crossover rail, the crossover rail engaging the inner and outer faces of that track rail upon which the tongue extends and further engaging each side edge of and overlapping the base of the rail. The crossover rail gradually increases in height from each end toward the center thereof.

RAIL JOINT.

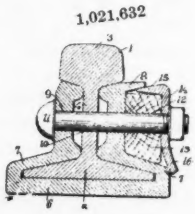
1,021,632—Edward Savoy, Chapel Hill, Tex.

A rail embracing joint chair having a rail head engaging member thereon, a clamping plate, means to draw the clamping plate toward the joint chair, and means on the clamp plate which co-acts with the joint chair to force the clamping plate into engagement with the head engaging member.

1,021,388.

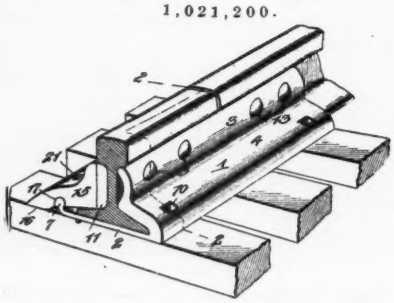


1,021,632



1,021,140.

1,021,200.



New Dixon Railroad Booklet

We have just prepared a booklet treating of the various Dixon graphite products for use on the railroad. The entire Dixon railroad line is treated of and all other matters excluded—this booklet is of interest only to the various mechanical railroad departments.

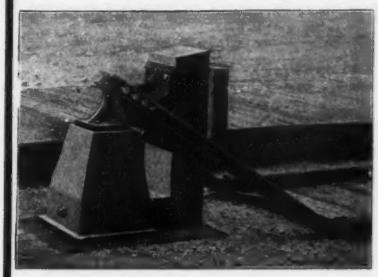
The application of dry graphite for lubrication, the use of Dixon's graphite greases, Dixon's Silica-Graphite Paint, crucibles, facings, crayons, etc., is all included in this booklet—a total of 40 pages. There is bound to be some matter to interest you here.

We have tried to make our booklet attractive in appearance as well as interesting to read, and to this end have included views taken of railroad stations and yards, stretches of track, signals, bridges, etc.

Write for copy of this booklet by number 187 R. R.

Joseph Dixon Crucible Co.

Jersey City, N. J.

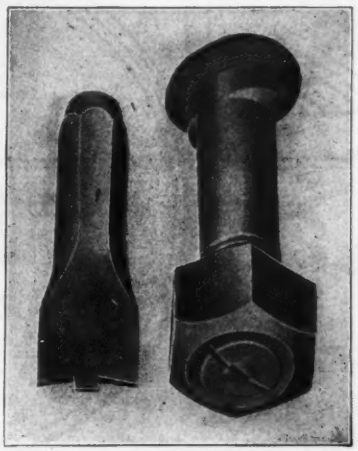


ELLIS PATENT BUMPING POST

Noted for Simplicity, Strength and Lasting Qualities. Adapted to all positions.

Mechanical Mfg. Co.,
CHICAGO. ILL.

THE CLARK NUT LOCK



Absolutely

SAFE

Absolutely

ADJUSTABLE

The Interlocking Nut & Bolt Co.
605-606 Arrot Office Bldg.
Pittsburgh, Pa.

ESTABLISHED 1861

The FROG, SWITCH & MFG. CO.

CARLISLE, PENN.

MANUFACTURERS OF

Frogs, Switches, Crossings, Switch Stands, Etc. Manganese Hardcentre Frogs

ALL KINDS PLAIN FOUNDRY WORK PRESSED STEEL RAIL BRACES

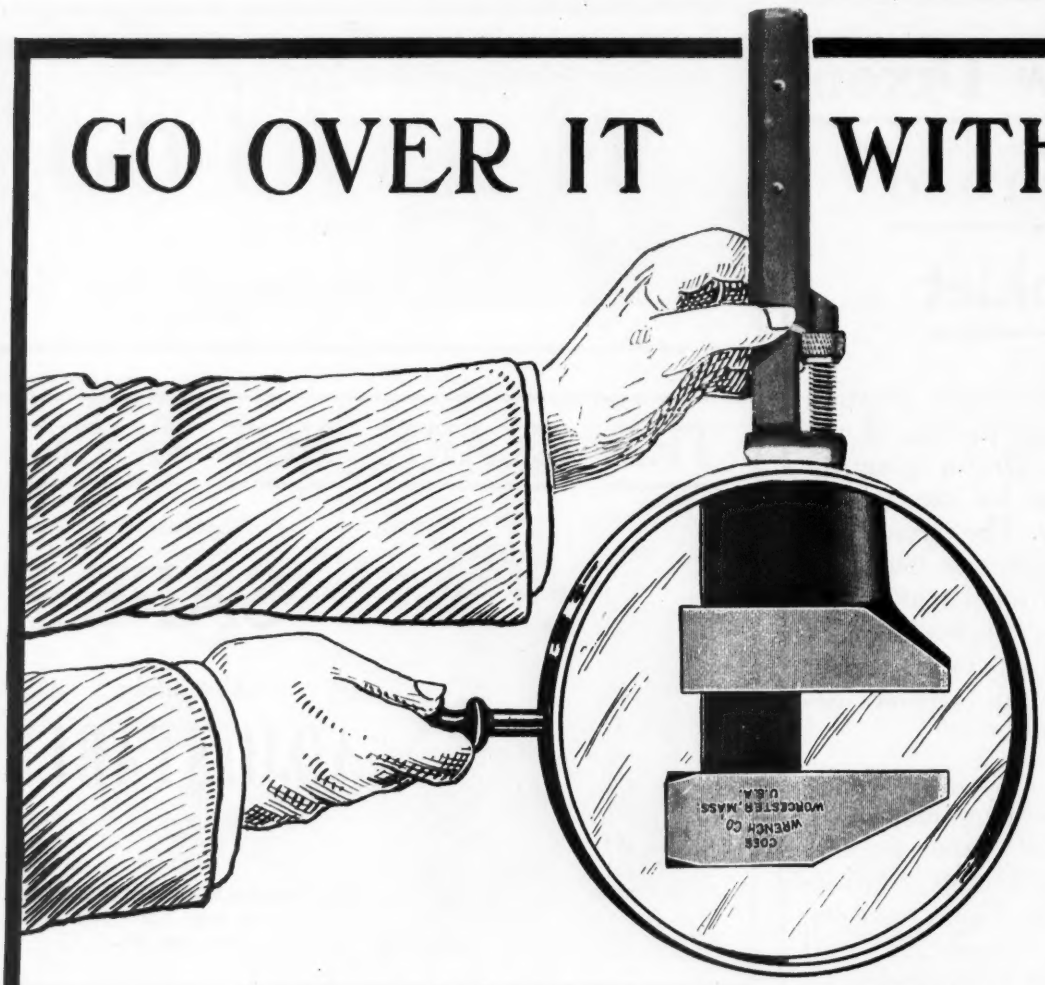
POSITION WANTED

Roadmaster's Clerk. 5 years experience as extra gang and yard foreman. References furnished. P. O. Box 315, Marion, N. C.

WRITE us if you want information concerning materials and tools not advertised in these pages :: :: :: ::

Railway Engineering and Maintenance of Way
431 South Dearborn Street :: :: :: CHICAGO

GO OVER IT WITH-



SLOW ABSORBED PRECISION

get the meaning and bearing of every detail, or ask an experienced mechanic—an authority whose word admits of no question—he will tell you that the

Coes "Genuine" Steel Handle Wrench

commands respect through its accurate clean cut work, deserving the position it has attained on account of its splendid quality, perfect finish and inimitable style—don't duck!—ask the man. It is a waste of time to look for anything better—let this be unalterably fixed in your mind. Made for use in extra difficult service, and in exposed places where heat or damp would injure a wood handle. Purposely made heavier for this duty and for special adaption to railroad and construction work.

RIGHT OFF THE REEL

There is no law governing the appearance of genius—nor do conclusions come ready made. A "Coes" surely has a strong independent attitude of its own—the quality is so thoroughly good—and so apparent that no one dare argue it down. Anything the jaws of a "Coes" will fit can be handled vigorously with no slips to turn the corners of the nut—it never bungles a job by stripping or defacing threads. Quality is remembered long after the price is forgotten. There is no slip shod method in the making of a "Coes"—any divergence of opinion is quickly removed by a near view of the line. See the near view—and look for the trade mark.

Five Styles and Fifty Sizes—a wrench for every need.

Apply to your dealer or direct to

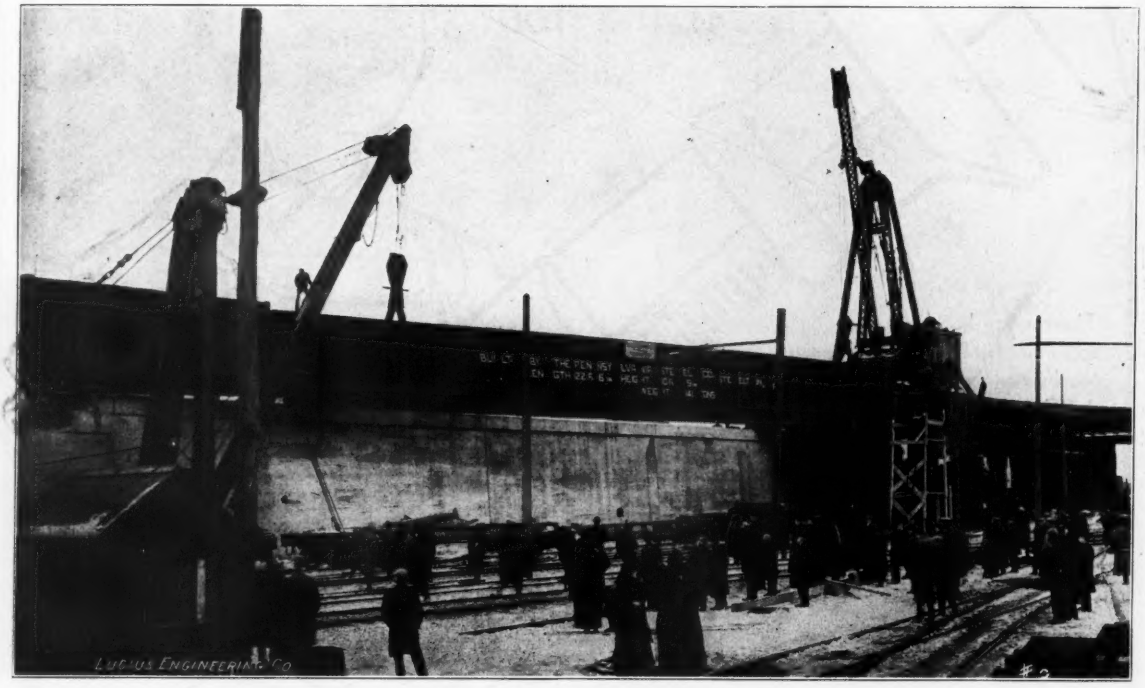
COES WRENCH CO.,

Agents: John H. Graham & Co.,
113 Chambers St., New York.
14 Thavies Inn, Holburn Circus, London, E. C.
Copenhagen, O. Denmark.

Agents: C. McCarty & Co.,
21 Murray St., New York.
438 Market St., San Francisco, Calif.
1515 Lorimer St., Denver, Colo.

Another Record Lift

141 Tons



Designed by the Boston and Albany R. R., F. B. Freeman, Chief Engineer., W. F. Steffens, Engineer of Structures
Erected February 4, 1912. Bridge No. 61. Worcester, Mass.

Remember
"Our Equipment insures Safety"

These cars erected the Heaviest Girder in the World—170 Tons one lift.
They were tested out singly on an 108 Ton Girder.
They can handle anything that you may require.
We want you to help us keep them busy.
We back them and our other cars with an organization that works in harmony with your officials.
It is this combination that makes possible the replacement of Bridges and Masonry at 30 openings in 5 months.
It is the same combination that will make the dirt fly on your new construction.
Put us on your Bidding List.

Lucius Engineering Company, Pittsburgh, Pa.

General Contractors

A "Graver Quality" Product

Type A
Bartlett-Graver Water Softener Showing top operated type. Also built for ground operation. "A type for every service."

One Reason for the Striking Success of the

Bartlett-Graver Water Softener and Purifier

is the fact that no chemical solution comes in contact with the chemical proportioning apparatus.

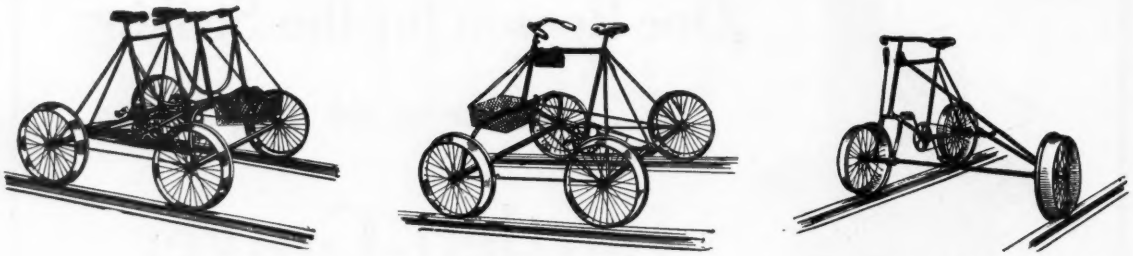
This is an *exclusive Bartlett-Graver feature* which eliminates the variation in chemical treatment commonly caused by chemical clogging up the proportioning apparatus. It is a feature which demands serious consideration where uniformly treated water is desired.

The latest addition to the Graver line which includes Oil Storage Tanks, Water Tanks and Towers, Standpipes, Stacks, Creosote Plants, Car Tanks and anything built from steel plate.

WM. GRAVER TANK WORKS

EAST CHICAGO, INDIANA

HARTLEY & TEETER



Light Inspection Cars are the Strongest and Lightest running known. The fact that we have not had a single complaint for the past year is proof absolutely that our cars are giving entire satisfaction. We shall be pleased to supply you with our new catalog that tells all about them.

LIGHT INSPECTION CAR CO.

HAGERSTOWN, INDIANA

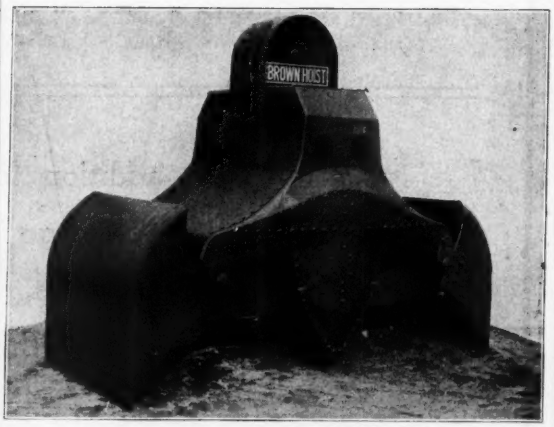
TUBULAR POLES
IRON OR STEEL

for
Signal, Electric Railway and Lighting Service.
Trolley Brackets Plain and Ornamental for Wood and Iron Poles.
Line Material.
Mast Arms.

Let us estimate on your requirements

ELECTRIC RAILWAY EQUIPMENT CO.
General Office, 2900 Cormany Avenue
CINCINNATI, OHIO

"BROWNHOIST"



Write For Particulars

The Brown Hoisting Machinery Company

Main Office and Works
CLEVELAND, OHIO

Branch Offices
NEW YORK PITTSBURG

'HUBBARD'

SINCE 1843

PROVED BEST BY EVERY TEST

Railroad Track Tools

Track Chisels
Spike Mauls
Claw Bars
Lining Bars
Tamping Bars
Track Punches
Track Wrenches
Mattocks

Tamping Picks
Clay Picks
Rail Tongs
Rail Forks
Tie Tongs
Sledges
Hammers
Wrenches

No. 68 STANDARD TRACK CHISEL

Shovels, Spades and Scoops

Track Shovels
Loco. Scoops
Coal Scoops
Charging Scoops
Ash Pan Scoops
Ore Shovels
Grain Scoops
Canal Shovels

Snow Shovels
Telegraph Shovels
Telegraph Spoons
Ditching Tools
Moulders' Shovels
Lime Shovels
Mining Shovels
Sidewalk Scrapers

STANDARD TRACK SHOVEL

WRITE FOR REPORT OF RAILROAD TESTS

WRITE FOR OUR NEW CATALOGUE

HUBBARD & CO.

NEW YORK 50 Church St. PITTSBURGH CHICAGO Fisher Bldg.

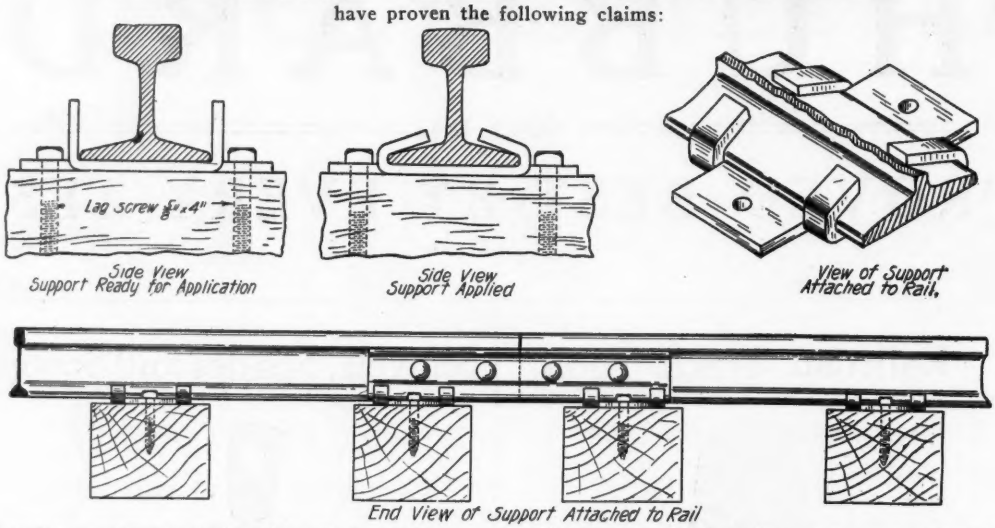
SELLING AGENCIES

BALTIMORE Weir & Wilson
LOUISVILLE W. P. Davis
BIRMINGHAM Solon Jacobs & Co.
ST. LOUIS Genl. Ry. Matl. Co.
DENVER Robt. J. Schlacks
ST. PAUL H. H. McNair

By a demonstration of over twenty months under both Passenger and heavy Freight traffic

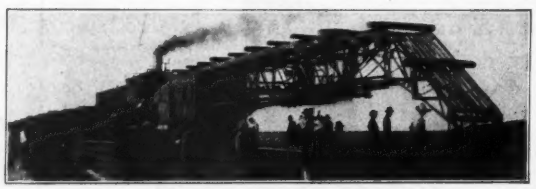
VAUGHN RAIL SUPPORTS

have proven the following claims:


Lag Screw ⅝"x4"
Side View Support Ready for Application
Side View Support Applied
View of Support Attached to Rail.
End View of Support Attached to Rail

No creeping, spreading or kinks. Supports do not loosen on tie or rail.
No deflection or mechanical injury to the tie.
No expense in maintenance since supports were applied.
Eliminates the purchasing of tie plates, because it is the best tie plate on the market, without its other merits.
Also eliminates rail braces, continuous joints, and anti-creepers.
It holds the rail absolutely in alignment either on Tangents or Curves.
It keeps your track to the exact gauge without the use of braces or other devices.
Preserves ties.
Permits the use of the less expensive class of timber.
It acts as an Anti-Creeper because it prevents wave motion of the track under traffic.
It avoids all possibilities of derailments due to rail breakage.
It does all these things, and at the same time costs no more than many tie plates now on the market, and is just as easy to apply.

VAUGHN RAIL SUPPORT COMPANY, Pierce Bldg., ST. LOUIS, MO.



GET ACQUAINTED WITH OUR
Combined Locomotive and Tracklaying Machine
that is operated and propelled by its own power. It hauls the material train and distributes in position the rails and ties with its own power. Saves use of one locomotive and at least 50 per cent in actual tracklaying force.
Send for our illustrated booklet, "Laying Track."
HURLEY TRACK LAYING MACHINE COMPANY
343 S. Dearborn St., Chicago.

OVER 50,000 MILES IN USE

ROLLED FROM BEST QUALITY STEEL

The Rail Joint Co. General Offices: 185 MADISON AVENUE, NEW YORK CITY

Makers of Base-Supported Rail Joints for Standard and Special Rail Sections, also Girder, Step or Compromise, Frog or Switch, and Insulating Rail Joints, protected by Patents.

CATALOG AT AGENCIES
Boston, Mass.; Chicago, Ill.; Denver, Colo.; Pittsburgh, Pa.; Portland, Ore.: St. Louis, Mo.; Troy, N. Y.

Sample Copy 50c

THE MONTHLY OFFICIAL RAILWAY LIST

For the correct title and address of any railway official

THE RAILWAY LIST CO.
431 S. Dearborn St. CHICAGO, ILL.

Philadelphia Turntable Company of Philadelphia

Locomotive
and other
Turntables

CHICAGO
Marquette Bldg.

ST. LOUIS
Commonwealth Trust Bldg.

Duluth Portable Steel Buildings

For Hand Car and Tool Houses
Switch and Signal Houses
Cement and Warehouses

Thoroughly Fire and Weather-Proof.

These Buildings are made sectional and shipped knocked down.

All parts are made to fit exactly and are easily put together.

Made in Standard Sizes 8'x10' to 16'x20'.

Fitted with Double Front and Single Rear Doors. Hinged Metal Side Windows, Glazed with Wired Glass.

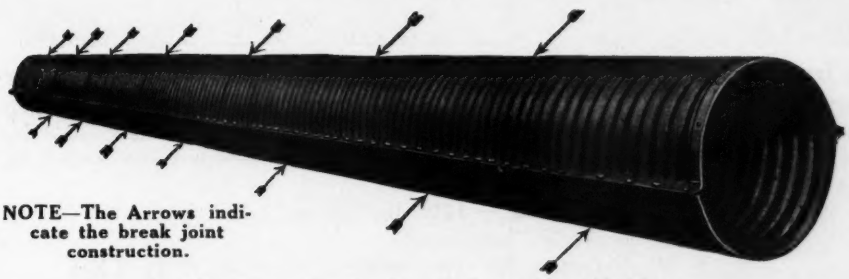
Write us for prices and full particulars.

Specifications and prices furnished for other than Standard Sizes upon request.

Duluth Corrugating & Roofing Co., Duluth, Minn.

McMartin Sectional Culverts

The Knock-Down Nestable Kind



NOTE—The Arrows indicate the break joint construction.

Easiest to Handle

Easiest to Transport

Easiest to Install

Manufactured under Letters Patent No. 999390.

Nests for Shipment and Simply Bolts Together on the Job

The Iron used is the renowned Iosa Metal manufactured expressly for Culvert purposes.

Made in 48" lengths with two half lengths to each culvert to make the break-joint construction.

The great strength is due to the reinforced flange-joint and the break joint construction.

Ends reinforced by half oval galvanived iron bands.

Used by many of the largest railway systems.

Duluth Corrugating & Roofing Co., Duluth, Minn.

"Indianapolis" Manganese Track Work "Weighs up in every way"—Is in a Class by Itself--Has a Record--Read on

The official weight of the golden R-N-R frog exhibited in connection with the Souvenir Award Guessing Contest at the Railway Appliances Show was officially determined at the close of the contest by Spencer Otis Co. of Chicago on one of their American Kron Ry. scales—tested and sealed by the Inspector of Weights.

The Secret { **Weight of the Golden Frog — 1206 lbs. 00 oz.** of the Success of "Indianapolis" **R—N—R** (Requiring No Renewals) during life of manganese **SOLID BOLTLESS MANGANESE FROGS AND CROSSINGS** } **Is Out**

and consists in

1st—in the **DESIGN.** Featuring the protection of connecting rails, Favoring the Manganese, eliminating joints and providing against renewals that would necessitate removing the work from track.

2nd—**Liberal** Weight and Sections—Sufficient metal with proper distribution to insure an absolute Safety Factor. We invite a comparison of Weights and Distribution of Metal.

3rd—The **Manganese Steel**—"Stag" Brand only (if it has an equal, we don't know of it—if there was any better, we would use it).

RESULTS—Never a Failure.

A Combination of (1) Durability, (2) Strength and (3) Security.

The Cheapest work is that which Costs the least for Up-Keep.

Attest—Many of the Largest Roads using extensively if not exclusively.

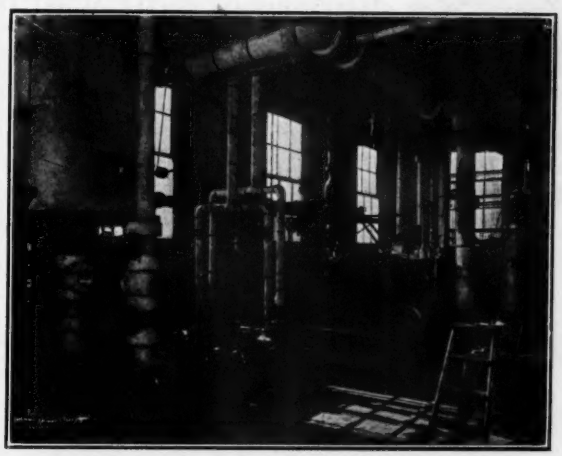
INDIANAPOLIS SWITCH & FROG CO., Springfield, Ohio

SALES OFFICES: New York Chicago Kansas City Spokane Portland Seattle Los Angeles San Francisco

WORK INSTALLED BY

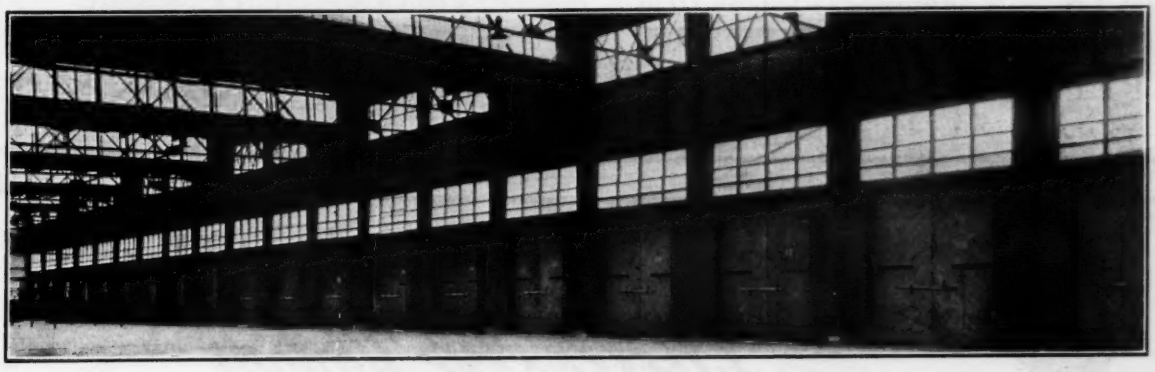
HORACE L. WINSLOW COMPANY

OLD COLONY BUILDING CHICAGO



POWER PLANT ERECTED FOR LAKE SHORE R. R. AT CHICAGO.

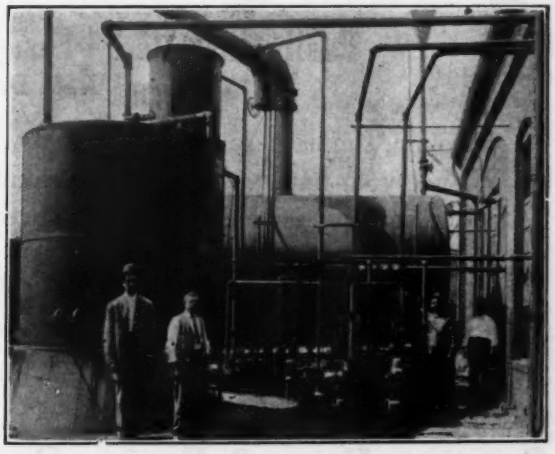
The Horace L. Winslow Co., Old Colony Building, Chicago, has installed a complete system of piping in the Root Street power station of the Lake Shore & Michigan Southern Ry., at Chicago; the work including high pressure steam, exhaust steam, feed water, drip-piping from all steam lines to traps, and compressed air lines; the latter comprising the after-cooling equipment. The illustration herewith shows the general appearance of this work, and conveys, at once, a sense of completeness and high class workmanship. (*Railway & Engineering Review*, April 15th, 1911.)



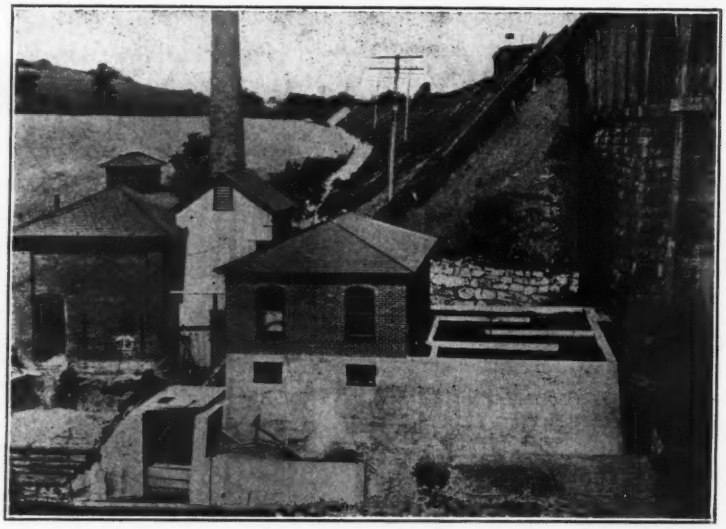
HEATING SYSTEM INSTALLED FOR STANDARD STEEL CAR CO., AT HAMMOND, IND.

The general design of the pipe work in this plant is of ample size, with full provision for expansion and contraction, and has ample area for the free flow of steam, air and water with minimum friction. Exceptionally strong hangers, clamps and anchors have been used, and, as a whole, it may be regarded as a good example of substantial and economical pipe installation. (*Railway Age Gazette*, March 24th, 1911.)

The Winslow boiler washing plant, which has recently been installed for the Richmond, Fredericksburg & Potomac Railroad, at Richmond, Va., condenses all the steam in the system up to the point of having a tank full of water at 212 degrees or better. The water already in the tank is the water that is heated, and water is not added because heat is added, but water is added only when there is surplus heat, or when water is drawn out to the point of requiring more water. Boilers are being filled with water 200 degrees to 220 degrees, washing out at 140 degrees to 150 degrees. Locomotives are turned complete in one hour and a half, leaving the roundhouse with one hundred pounds steam.



WINSLOW BOILER WASHING PLANT INSTALLED FOR R. F. & P. R. R., RICHMOND, VA.



Concrete Filter Plant, Philadelphia & Reading R. R.

Clear Water

is just as necessary for boilers as soft water.

We build plants for either purpose.

We are water specialists

Purify for all purposes

WATER SOFTENERS
Continuous—Intermittent

WATER FILTERS
Gravity—Pressure

PITTSBURGH FILTER MANUFACTURING CO.
KANSAS CITY PITTSBURGH CHICAGO

Stop! You're Working Too Hard—

Belle Isle Motors

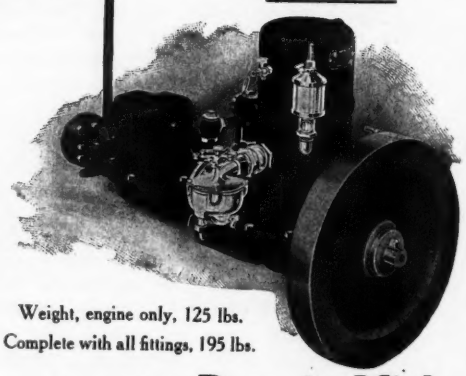
will propel your hand car up the steepest grades, with the heaviest load the car will accommodate.

Easily Installed—Easily Operated

Chain or Belt Drive

A plain, simple gasoline engine that will change your hard-pulling, back-breaking, slow running section car into a speedy and reliable motor car.

4 to 5 H. P.
= 20 Man Power



Weight, engine only, 125 lbs.
Complete with all fittings, 195 lbs.

FITS ANY SECTION HAND CAR

Smaller Size for Velocipedes

Write for Catalog No. 40.

Concrete Form & Engine Co., 502 Wayne County Bank, Detroit, Mich.

THE PRODUCTS OF THE

Kalamazoo Railway Supply Co.

are *standard* for ease of operation and durability

Kalamazoo Hand Cars

are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

The Moore Track Drills

are made of selected materials, best adapted for their several purposes. The workmanship is first class and above criticism. The spindle has a ball thrust bearing, especially designed to relieve the friction. All bearings are designed to give durability.

Any style, over-clutch or under-clutch, as desired.

The Jenne Friction Jack

has steel pivots, bronze boxes, malleable iron frame and lever socket, wrought iron rings, hanger and lifting bar. All parts replaceable from catalogue.

Three sizes, adapted to all classes of track work.

Catalogue of Track and Railway Supplies on Request

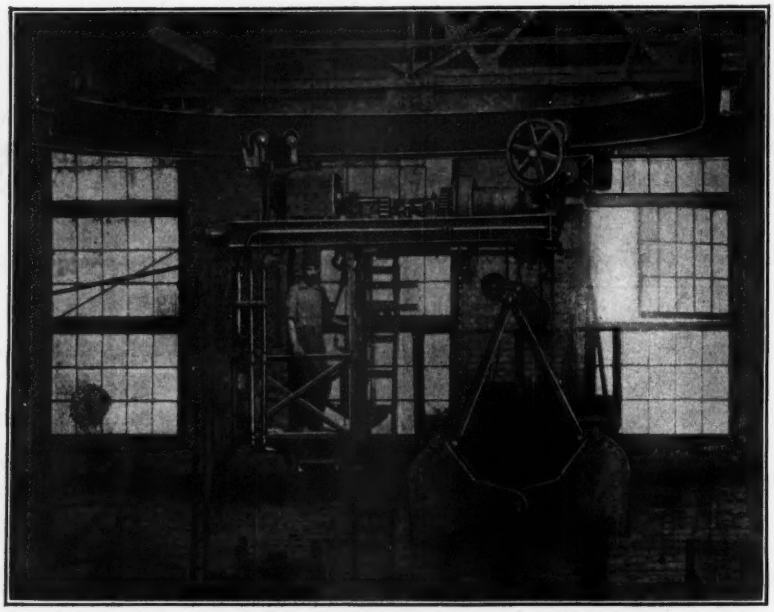
Kalamazoo Railway Supply Co.

MANUFACTURERS

KALAMAZOO, MICH.

Western Representative: W. K. KENLY COMPANY, Chicago

This Mono-Rail Crane Williams Bucket installation effected a saving of over $200 per month handling coal and ashes at the plant of a large Paper Co. in Michigan



WILLIAMS

BUCKETS

In All Sizes **Made of Steel Throughout** For All Purposes

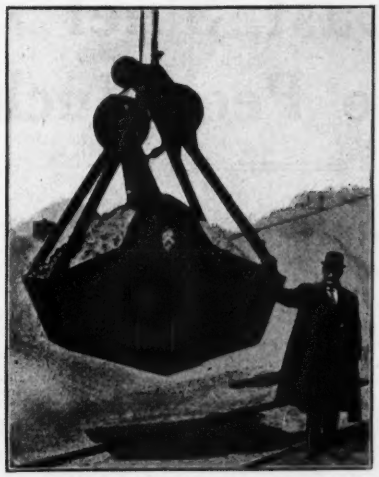
STRONGEST AND MOST DURABLE BUCKETS MADE.

The result of over twenty-five years practical experience.

This illustration shows three of the many buckets furnished the U. S. Government for the Panama Canal. Each of these buckets on the trial tests handled 350 yards *per hour* of hard packed pumped sand from sand scows.

THE G. H. WILLIAMS COMPANY

ROCKEFELLER BLDG., CLEVELAND, OHIO



FAIVRETTE BUCKETS
ARE
GOOD DIGGERS

THE
STRONGEST AND MOST DURABLE BUCKETS MADE

BUILT OF STEEL THROUGHOUT IN ALL SIZES

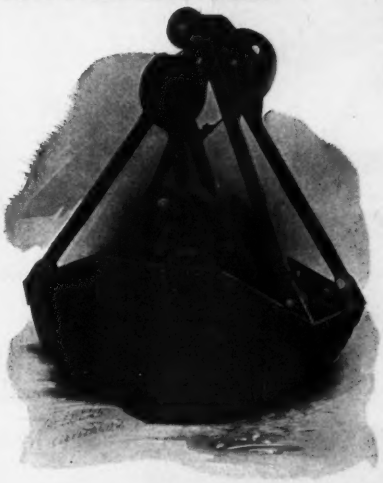
Write for Full Information

WE MAKE

Iron Ore
Slag Handling
Coal
Sand and Gravel
Excavating

BUCKETS

IN BOTH
Double and Single Line Types
ALSO
SPECIAL BUCKETS

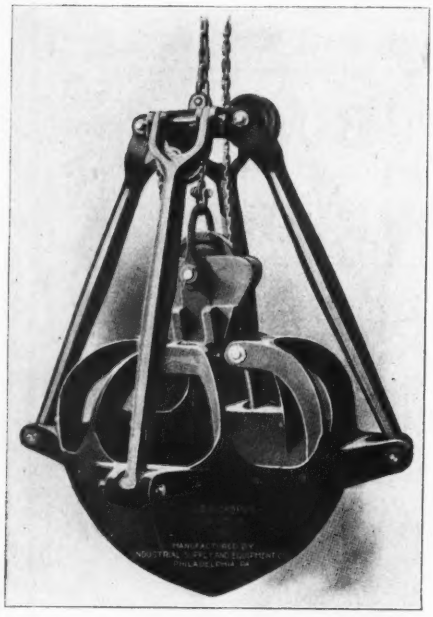


We specialize in forms for plain and reinforced concrete pipes.

BEL
c
Revolving Derricks
a
T
Of the Latest and Most Approved Types

SPECIAL
Excavating Machines
FOR ALL WORK

THE G. H. WILLIAMS COMPANY
CLEVELAND, OHIO



Rickards Cast Steel Orange Peel Buckets

The Bucket for Hard Service

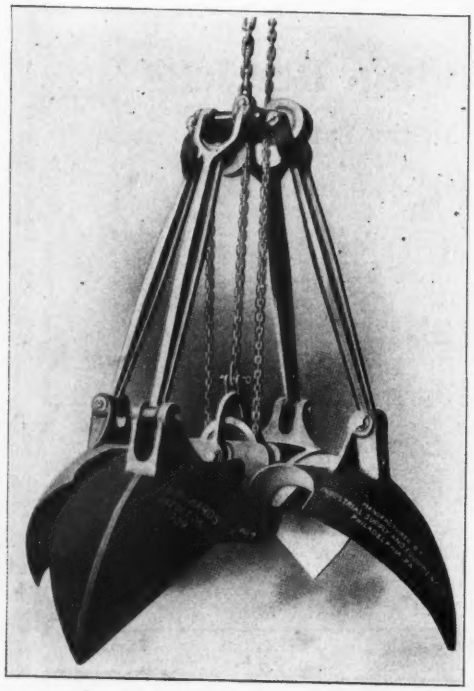
Rickards Orange Peel Buckets are constructed with four curved triangular cast steel blades, and when closed form a tight semi-spherical bowl, which holds the excavated material.

Rickards Bucket parts are interchangeable and are numbered and lettered. Reference to the number of the bucket being all that is necessary in ordering any part.

The Center Block is made of cast steel and fitted to carry and allow the bucket to hang central at all times.

All buckets are fitted with chain wheels, as thi[redacted]sirable. B[redacted]e fur-ni[redacted]

[redacted]o de-si[redacted]ed on th[redacted]n buy sa[redacted]d and [redacted]



T[redacted]nd Equipment Co.

407 Sansom Street, Philadelphia

AGENTS:—J. H. Allen, 2 Rector Street, New York City; Willis Shaw Machinery Co., 39 S. LaSalle St., Chicago; W. H. Dayton, Security Building, St. Louis; J. M. Van Harlingen, Chandler Building, Atlanta; A. H. Van Winkle, 160 Beale Street, San Francisco; L. W. Miller Co., Boston.

EXCAVATING BUCKET

BEST ON EARTH

Standard Bucket Type "C" Closed

These

BUCKETS

are the

Standard Bucket Type "D" Closed

Most Durable Buckets Made. Built Entirely of Steel

IN ALL SIZES

A BUCKET FOR EVERY SERVICE

Write

THE G. H. WILLIAMS CO.

CLEVELAND, OHIO

FOR

INFORMATION

and

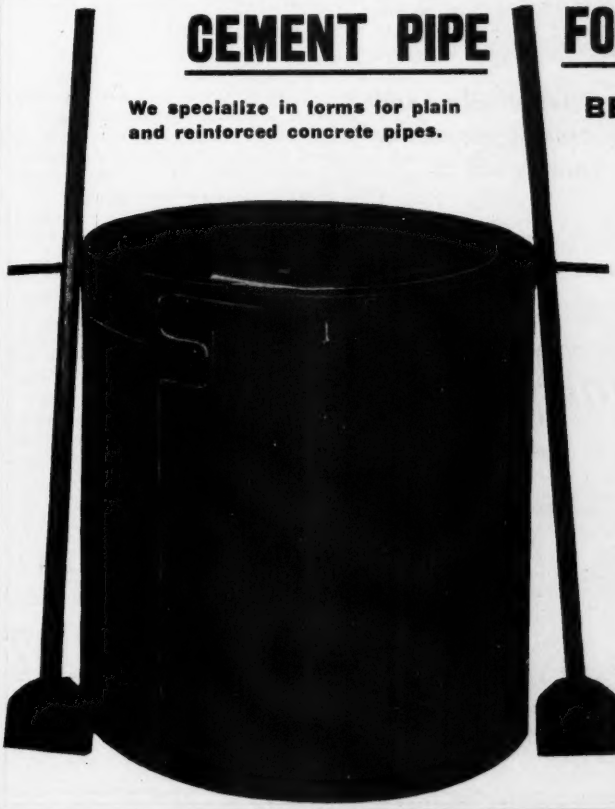
PRICES

Single Rope Bucket Closed View

Single Rope Bucket Open View

CEMENT PIPE FOR CULVERTS

We specialize in forms for plain and reinforced concrete pipes.



BELL MOUTH

or

GROOVE and TONGUE

Cheap, Durable, Strong

All Sizes

Diameters, 1-5 feet

Length, 2-6 feet

Any thickness of wall

State your requirements and prices on forms and reinforcement promptly furnished.

MARSH CO.

Old Colony Bldg. - CHICAGO

Carefully Corrected Copy in Consecutive Issues

"An advertising solicitor was telling me the other day that of 13 pages he had last year from a certain territory, nine had disappeared from the field. I do not know whether this is a fair average for the general field or not, but I think that it is approximately so.

"What becomes of those advertisers who drop out? Either they had nothing worthy to advertise, or they did not have enough money, or they did not know how to advertise."—*George French in "Advertising and Selling."*

Advertise *consecutively* and avoid giving buyers an erroneous impression of your product.

Compels the Consideration of Conscientious Consumers

STOP!

Here is an up-to-date device for the up-to-date man.

Save yourself trouble and expense.

No more broken posts.

No more maintenance cost.

No more damage to equipment.

Let us prove its worth to you as we have to others.

THE Saunders Car Stopper is not a theory, but a tested, effective and economical device. Over one hundred railroads are using them. One road alone has more than one hundred.

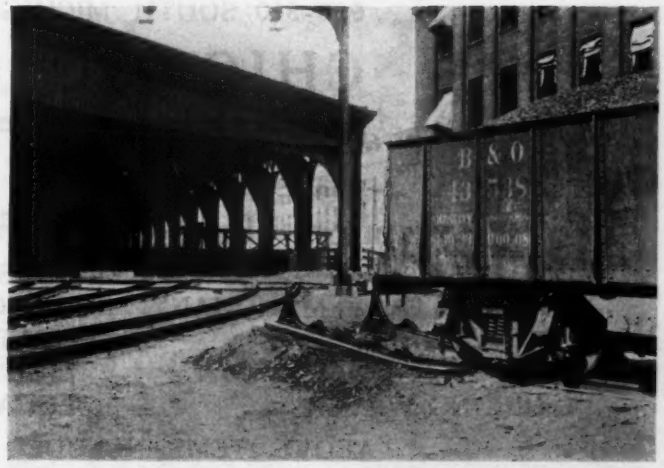
This stopper will stop anything that the patented rigid posts will, but without damage to either car, contents or stopper.

Have you ever had a car standing close to a rigid post when a forced coupling was made? Wasn't there a great strain on both the car and post? And in time hasn't that post been knocked out by a very light impact? Why not avoid all this by using the Saunders Stopper?

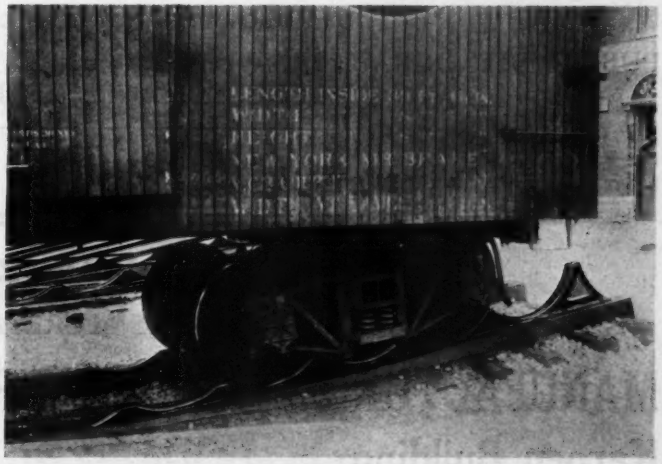
They are so cheap that you should not be without one at every open end track.

The engineer can tell the moment he touches the first corrugation—which enables him to stop *at once*. With a rigid post he cannot "feel" the end of the track until he hits it.

The stopper requires *two feet more* space than the average post, *but* you can use at least five more feet, if necessary, by pushing the car back on the stopper.



Let us explain our
TRIAL PROPOSITION



SOUTHERN RAILWAY SUPPLY CO., ST. LOUIS U. S. A.

Permanent Manufacturers' Exhibit Railway Supplies and Equipment

KARPEN BUILDING

900-910 SOUTH MICHIGAN BLVD.

CHICAGO, ILL.

Over 26,000 Square Feet Divided into Spaces to Suit the Exhibitor. Each Space Furnished with:

ONE DESK
ONE TABLE } MAHOGANY
THREE CHAIRS
JANITOR SERVICE
DRINKING WATER
RUGS
UNIFORM SIGNS FOR ALL
HEAT
LIGHT
LOCAL TELEPHONE SERVICE

ABOVE ITEMS INCLUDED IN RENTAL

The Following Service can be had:

PUBLIC STENOGRAPHER, WESTERN UNION & POSTAL TELEGRAPH AND LONG DISTANCE TELEPHONE

Exposition is Accessible from 8:00 A. M. to 10:00 P. M.

FOR INFORMATION OR RESERVATIONS

ADDRESS SECRETARY

MANUFACTURERS' EXHIBIT OF RAILWAY SUPPLIES

Karpen Building CHICAGO, ILL.

DO YOU KNOW?

BANKS designed the first assembled Copper Oxide Cell with Single Suspension.

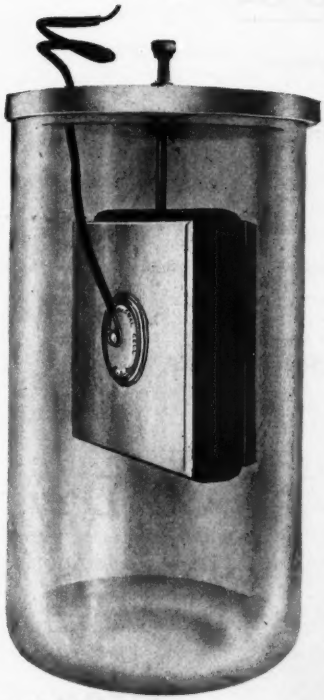
BANKS designed the first Assembled Copper Oxide Cell with Zinc beneath the Oil or Solution line. Zinc had wire attached.

BANKS designed the first Copper Oxide-Zinc-Alkaline Combination for Track Circuit Work.

BANKS was the first to Compress Copper Oxide in a Containing Grid of Metal for the ideal Negative Plate.

BANKS was the first to give you Rigid Construction in an Assembled Element with great Mechanical Strength.

BANKS was the first to give you a Track Circuit Cell with Automatic features in giving you a predetermined internal resistance during the life of the Elements.

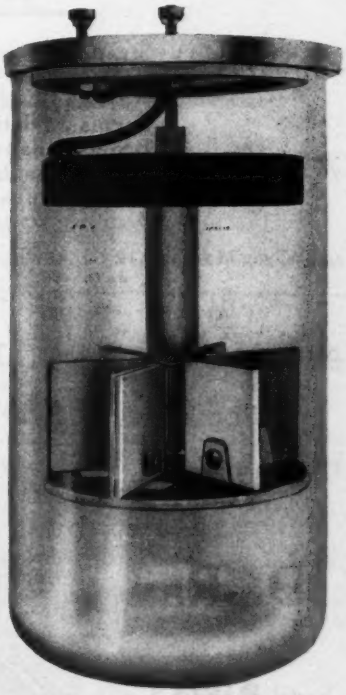


BANKS SIGNAL CELL, R. S. A.

ALL
of the Above Valuable Features are Contained in the

BANKS
Signal Track Circuit
CELLS

Which are Equipped With
N-W BINDING POSTS



BANKS TRACK CIRCUIT CELL

FOR FURTHER INFORMATION ADDRESS

Sole Sales Agents

Northwestern Construction Co.

HUDSON TERMINAL 50 CHURCH ST., NEW YORK CITY

JOHNSON CAR REPLACERS

Types Z, A or B, left hand

In general use by

Standard and Logging Railroads Mines and Contractors

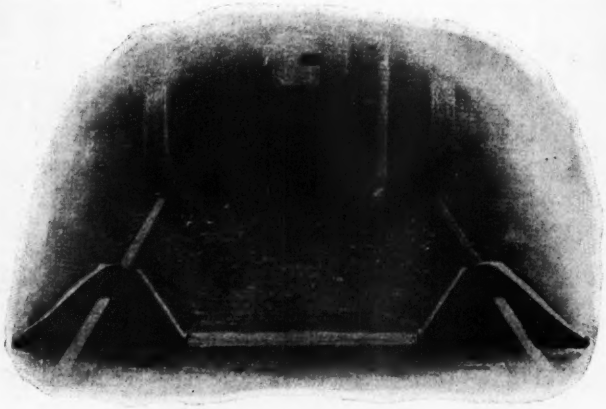
Types C and M, right hand

THE JOHNSON FROG:

Straddles the rail—needs no spikes, clamps or fasteners
Rests on rail both front and rear
Adjusts itself to different heights of rail
Forms a friction grip with rail during the operation
Brings rails to gauge during replacement
Distributes the load on the rail and tie
Special types for Steel-ties and Street Car rails

	Range	T. Rail	Capacity	Throat opening	Wgt. each.
Type M	for rail 12 - 45 lbs.	if not over 3½ inches high	20 Ton Locomotive	2 inches	30
" C	" " up to 65 "	" " 4½ " "	30 " "	2½ "	60
" B	" " 80 "	" " 5 " "	50 " "	3¼ "	110
" A	" " " " 100 "	" " 5½ " "	80 " "	3½ "	145
" Z	" " " " 100 "	" " 6 " "	100 " "	3½ "	165
" AA	" " " " 100 "	" " 6 " "	200 " Wreck Outfit	3½ "	275

Will De-Rail also



30 Days Trial Free

After Rerailing 50 Ton Car

THE JOHNSON WRECKING FROG CO.

CLEVELAND, OHIO

The Trackman's Helper

Revised Edition

by J. KINDELAN

A Practical Guide for Track Foremen

Thirtieth Thousand

"It is so very plain and easily understood, its value to men of ordinary education cannot be estimated."—*D. A. Dale, Roadmaster, West Shore Ry.*

"I find the Revised Trackmen's Helper the most generally instructive and useful book for trackmen that is now obtainable. I think every Track Foreman and Roadmaster should have a copy of it."—*D. Sweeney, Roadmaster, C., R. I. & P. Ry.*

350 pages; fully illustrated, 5¼x7½ inches.
Price $1.50, net postpaid.

Practical Switch Work

By D. H. LOVELL

Division Superintendent Pennsylvania Ry.

An Instructor and Guide for Roadmasters, Section Foremen and Construction Foremen

This book is presented in a very clear manner, which is at once simple, thorough and practical. Mr. Lovell has mastered this difficult subject in its entirety, and one of the best features is that it is written in plain language.

The contents include chapters on General Turn-Outs; Stub and Split Switches; Analysis of Curves; and a large number of tables for the quick and correct construction of any switch.

Cloth, 174 pages; 4½x6¼ inches.
Price $1.00, net postpaid.

Maintenance of Way Standards

By F. A. SMITH, M. E., C. E.

In Every-day Use by 20,000 Trackmen

This book, which has met with general approval, is compiled with a view of supplying a work which can be used on any road in any part of the country. It contains in one handy volume the present rules and practice in the Road Departments of the principal American Roads, information which is of the highest value and service to trackmen in every-day work.

"I am well pleased with Maintenance of Way Standards and consider it of value to all trackmen."—*J. A. Roland, Roadmaster, Chicago & Northwestern Ry.*

"Maintenance of Way Standards is very instructive and should be in the hands of every official in charge of our road-beds."—*Hiram J. Slifer, Div. Eng., C. & N. W. Ry.*

Over 300 illustrations including working drawings; 600 pages; size 5½x7¼ inches. Price $1.50, net postpaid.

Railway Curves

By F. A. SMITH, M. E., C. E.

This book is written especially for practical trackmen who desire a guide so that they may become better acquainted with the elementary principles of railway curves and to enable them to adjust their curves satisfactorily independent of the civil engineer. All complicated formulae or calculations have been omitted in order to produce this practical work.

Cloth, 4x6¼ inches; 50 pages; including tables and diagrams. Price $1.00, net postpaid.

Standard Turn Outs on American Railroads

A Practical Hand Book for Roadmasters and Track Foremen

By F. A. SMITH, C. E., M. E.

Introduction by J. M. MEADE, Res. Eng. A. T. & S. F. Ry.

A New Handy Reference Volume—Giving drawings of Standard Split and Stub Switches and Full Descriptive Details arranged for convenience and ready reference when putting in Switches.

THE ONLY BOOK of the Kind Published.

Leather, 4½x7¼ inches, 41 pages.
Price $1.00 net, postpaid.

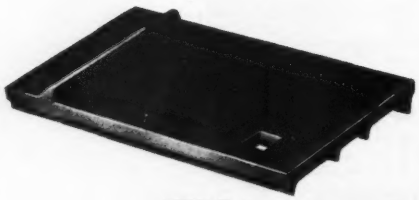
Descriptive Circulars upon Application

The Myron C. Clark Publishing Co.

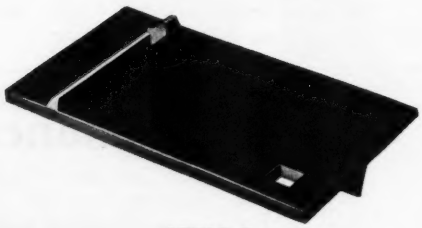
537 S. DEARBORN STREET, CHICAGO

ROLLED STEEL SHOULDER
TIE PLATES

ROLLED FROM O. H. STEEL



STYLE A



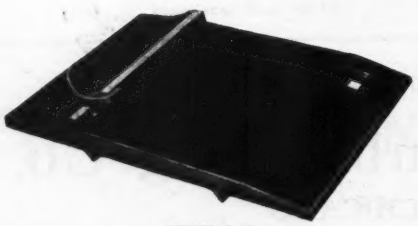
STYLE B

STANDARD SPIKES

THE HART STEEL COMPANY

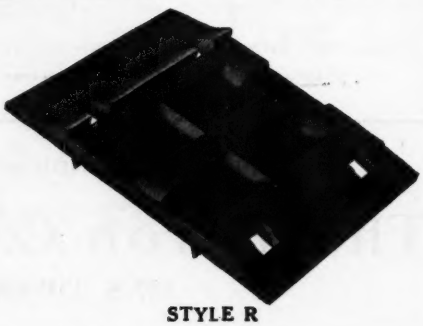
ELYRIA, OHIO

Plates and Spikes Made by The Elyria Iron & Steel Co.



STYLE O

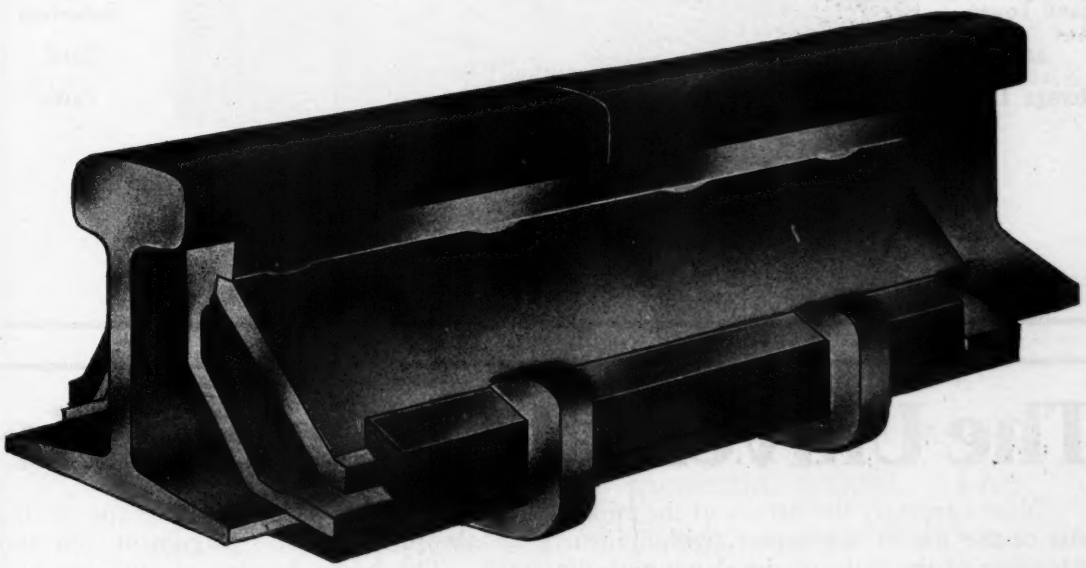
Our Catalog Shows 20 Styles of Tie Plates



STYLE R

The Enright Boltless Rail Joint

Consists of a bottom plate, two side plates and two wedges which when assembled hold the rail securely and in perfect alignment. The side plates have lugs which fit into the bolt holes of the rails keeping them in position, at the same time allowing for expansion and contraction.



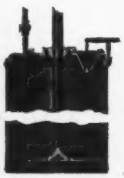
The joint secures a hold on the ties by means of the lugs shown in illustration. The side plates are wedge shaped, and are tightened by driving. The joint is perfectly bonded for track circuits, by a copper strip in the bottom plates, engaging with copper plugs in the rail ends. This joint has stood up excellently under heavy traffic.

Enright-Frey Railway Equipment Co.

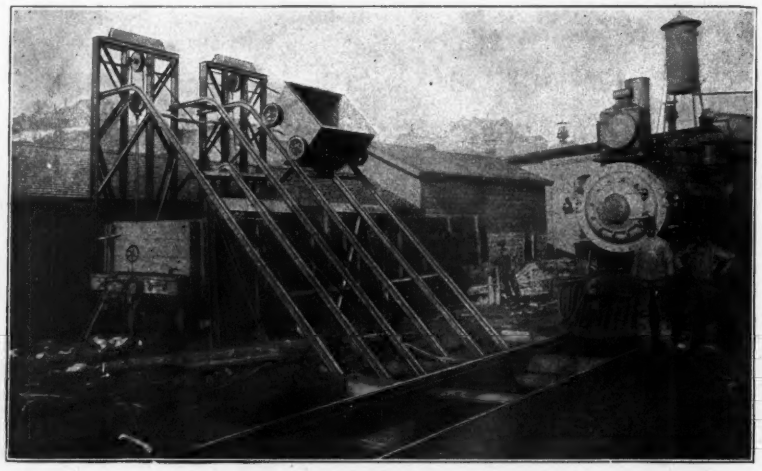
801 Hibernia Bldg., New Orleans, La.

The Robertson Pneumatic Cinder Pit Conveyor

Pneumatic Sand Hoist



Sand Tower and Storage Tank



Robertson Sand Dryer

Robertson Sand Valve

WM. ROBERTSON & CO.

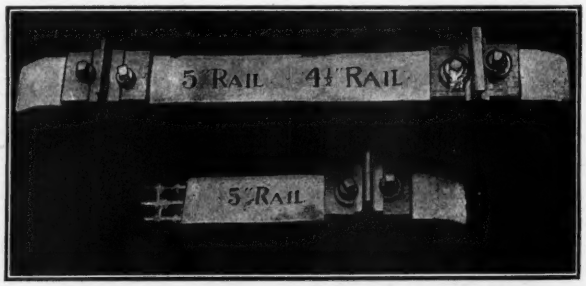
20 W. JACKSON BLVD., CHICAGO

The Universal Concrete Tie

Note carefully the details of the spiking device and the peculiar "V" shape of the base of the Tie at the center, which insures an absolutely perfect alignment, obviates spreading of the rails, or the slewing of the track. The heavy hardwood cushions preserve the rolling stock as well as the tie; last for six to fifteen years, and are then almost instantly removed by the loosening of the screw spikes by one man.

The Percival Patents

In use under various Trunk Line Railways for five and six years past.



For further facts and full evidence, address the

UNIVERSAL CONCRETE TIE COMPANY

1408-9 Whitney-Central Bldg.
NEW ORLEANS, LA.

The above cut illustrates the Universal Concrete Tie.

Trains are running sixty miles an hour over these ties, and have been so running for more than five years, yet they have had no repairs, realigning or even tightening of the spiking devices.

The reinforcement of our ties consists of four corrugated bars, the approximate length of the tie, and varying in size from 1-2 in. to 1 in. These are secured in proper shape by electro-welding the heavy binding wires. The truss core of the tie thus forming a complete unit within itself.

The best tie for terminals, because it is permanent.

The best tie for yards, because it is fire proof, rust proof, and will hold rails true to gauge.

The best tie for main lines and heavy traffic, because it is absolutely dependable under all conditions, as we can show in roads using them.

Winan's Improved Rail Joint

Has ***made good*** on a large number of railways. It has been installed under all conditions of traffic and roadbed and has ***made good*** in every case. It holds up the joint under severest use.

The design is such as to obtain maximum strength, using a section which requires the minimum amount of metal, and therefore of minimum weight. The downward projections at the ends engage with the sides of the joint ties; the protruding stiffener engages with the opposite side of the ties; the spikes are therefore relieved from practically all longitudinal strains, preventing throat cut spikes.

This Joint will reduce your maintenance, and keep your track in better surface

Winan's Patent Rail Joint Co.
PORTLAND, OREGON

Railway Master Mechanic

has, within the past three years, fought its way to a recognition appreciated only by those who have closely watched its progress.

Its circulation has been greatly increased by a strong subscription campaign, not indiscriminately, but by careful selection among those mechanical officials who are worth while. Its shop circulation exceeds that of all other publications in the field.

The June and July special issues are anticipated by all interested in the work of the Mechanical Association. The 1912 numbers will be larger and more interesting than ever.

Requisitions for supplies and equipment are now being made in quantities. They have been sidetracked in the offices of the purchasing departments only temporarily. Within the next few months they will be released by appropriations. The manufacturer or dealer who wishes a part in this business must advertise ***now.***

The Railway Master Mechanic being a monthly publication will carry a full page advertisement at less cost than that of a quarter page run consecutively in the weekly journals.

You must advertise consistently, therefore consecutively. You must reach the proper officials. Then why not do it efficiently by using the Railway Master Mechanic?

THE RAILWAY LIST COMPANY

MANHATTAN BUILDING **CHICAGO**

Bargains in Contractors' Equipment

CLAM SHELLS.

1 2 yd. Hayward
1 ¾ yd. Owen.
1 1 yd. Owen
1 1¼ yd. Hayward Orange Peel.
1 1⅝ yd. Hayward Clam Shell Bucket.
1 1 yd. Hayward Orange Peel Bucket.
And others

CARS.

40 3 yd. K. & J. 36" Gauge, Fine
38 4 yd. K. & J. 36" Gauge, Fine
20 12 yd. Western Standard Gauge Air Dump.
10 6 yd. Western Standard Gauge
20 Hopper Bottom Gondolas, 60,000 capacity
60 Western, 1½ yd. 2 way side dump, overhauled cars
20 Western, 4 yd. 2 way side pump, modern, dia. frame cars
12 Continental, 6 yd. A 41 dia. frame, latest type cars, fine.
And others.

AIR COMPRESSORS.

1 10x10x10 Laidlaw Dunn Gordon
1 12x12x14 Rand Straight Line Steam Driven
1 12x12 Ingersoll Belt Driven
1 11x14 Franklin Belt Driven
1 16x16x18 Ingersoll Steam Driven
1 20x20¼x24 Ingersoll Steam Driven.
1 24x24¼x30 Ingersoll Steam Driven
1 14x14x16 Ingersoll Steam Driven
1 Ingersoll-Sergeant, Class "H C," duplex air compressor, steam 10¼x10 capacity 348' to 100 lbs
And others.

ROCK CRUSHER.

1 No. 2 Gates
1 No. 3 Style D Rock Crusher, Gates
1 No 4 Austin Rock Crusher and Screen
2 No. 5 McCully's Crushers, manganese steel head and concaves, nickel steel shaft, with elevator and screens
1 No. 5 Gates, Type D, Rock Crusher 40" x10' screen and 48' No. 5 Elevator and Backgear, with extra new eccentric and power plant.
1 No. 6 Style, Type D, Gates Crusher, shop No 3537
1 No. 7½ Gates Crusher, Style K
1 No. 8 Gates Crusher, Style D
1 No 10 McCully Crusher with 60' elevator and a 60"x25' screen good as new.
2 No. 4 Champion 1 in Crushers on trucks with elevators.
1 10x18 Ft. Wayne on truck with elevator and screen.

DRAG LINE EXCAVATORS.

2 Heyworth-Newman Drag Line Excavators, 100' boom, 3 cu yd bucket, complete.
1 Lambert Page, 1½ or 2 yd., full circle, 50 ft. boom, 18 ft. rail circle, 3 drum hoist and boiler and compound swinging engines.
1 Lidgerwood-Crawford with 1½ yd. Page Bucket—60' boom
1 Lidgerwood-Crawford Steel Machine with 60' boom—2 yd. bucket.
1 Kearns-Page with 70' boom—1½ yd bucket.
And a lot of others.

HOISTING ENGINES.

1 6¼x10 American D. C., D. D., with swinging gear and boiler
1 7x10 Lidgerwood D. C. D. D., with boiler
1 7x10 Lambert D. C., D. D., with boiler
1 8½x10 Lambert D. C., D. D., with boiler and swinging gear.
1 8½x10 Lambert D. C., D. D., with boiler and 6 independent clutch winders.
1 Lidgerwood Cableway Engine, 9x10, link motion, D. C., D. D., drums 33", 1 500 span, 1½" cable, complete with towers and erecting plans.
1 American Hoisting Engine, 6¼x10, D. C., D. D., with slowing gear and boiler
4 Lambert Hoisting Engines, 7x10, with boiler, D. C., D. D.
2 American Hoisting Engines, 8¼x10, 3 drums, double cylinder, with independent slowing engines.
And a lot of others.

LOCOMOTIVES.

5 10x16 Porter's 36" Gauge.
2 11x16 American Standard Gauge.
1 35 ton Penn Saddle Tank
2 50 ton Moguls
4 Porter Locomotives, 36" gauge, 14 ton, 9x14, Dinkey fully overhauled, A-1.
1 Baldwin Locomotive, 36" gauge, 24 ton, 12x16 Saddle Tank, 6 wheel connected, fair order
4 Davenport Locomotives, standard gauge, 18 ton, 10x16 Saddle Tank, 4 drivers, rebuilt
And others.

LOCOMOTIVE CRANES.

1 10 Industrial, almost new
1 McMyler Locomotive Crane, 4 wheel, M C B. truck standard gauge, boom 33' 10 ton
1 10 ton McMyler Locomotive Crane, standard gauge, with 35' boom, great bargain
1 20 ton Interstate Locomotive Crane with —' boom, double trucker, only used short time.

DERRICKS.

Tell us what you want.

CABLEWAYS.

1 1,100' Span Lidgerwood complete.
1 1,500' Span Lidgerwood complete.
1 800' Span Flory complete.
1 650' Span Lidgerwood complete.
And a lot of others

DRILLS.

2 No 0 Star Outfits complete.
12 U B 2 Sullivan Air Drills.
10 E. 24 Ingersolls.
And a lot of others.

DREDGES.

1 1 yd. Bellefontaine.
1 ¾ yd. Marion.
1 1 yd Fairbanks.
All good.

CONCRETE MIXERS.

1 No. 11 Cube Concrete Mixer on truck with gasoline engine and side loader, good as new
1 No 2 Smith Concrete Mixer with engine and boiler on trucks.
1 No 2½ Smith Concrete Mixer on trucks, engine and boiler almost new.
1 No. 1 Smith on truck with engine and boiler and side loader
1 No. 0 Chicago on truck with engine and boiler.
1 No. 2 Chain Belt with engine and boiler and side loader.
1 No. 3 Chain Belt with engine and boiler and side loader.
1 No. 4 Ransome on skid with engine.
1 1 yd. Smith on skid with engine.
4 No. 2½ Foote Continuous on truck with gasoline engine.
1 No. 17 Cube on truck with engine and boiler.
And a lot of others.

ROLLERS.

1 10 ton Kelley Road Roller.
1 10 ton Monarch Road Roller.
1 10 ton Case Road Roller.
1 10 ton Universal Tanden.
1 8 ton Kelley Tanden.
1 8 ton Erie Tanden.
2 5 ton Kelley Tanden.
1 3 ton Iroquois Tanden.
And others.

TRACTION ENGINES.

1 22 ton Buffalo-Pitts.
1 26 ton Advance.
1 22 ton Reeves.
1 16 ton Case.
And others.

PILE DRIVERS.

1 No. 1 Vulcan Steam with 65' load capacity.
1 No. 2 Vulcan Steam with 50' load capacity
1 No. 2 Vulcan Steam without load.
And others

PUMPS.

A lot of centrifugal and steam pumps—tell us what you want.

STEAM SHOVEL.

1 No. 0 Thew Steam Shovel, ⅝ yd dipper traction, just rebuilt.
1 No. 1 Thew Shovel, ¾ yd. dipper, used only three months.
1 No. 1 Vulcan Revolving Shovel, 1 yd dipper, almost new.
1 30 ton Little Giant Traction Shovel, 1½ yd. dipper, shop No. 1728.
1 Model 20, Marion Shovel, 1¼ yd. dipper, shop No. 1024.
1 55 ton Bucyrus Shovel, shop No. 1468, specially built for rock, 2 yd. dipper
1 Model 60, Marion Shovel, 2½ yd. dipper, splendid machine.
1 Vulcan Shovel, 70-ton, 3 sets engines shop No. 1150, 2½ yd. dipper.
1 75 ton Class "D" Heavy Duty Vulcan Shovel, 2½ yd. dipper, good as new.
1 Bucyrus Model "C" Shovel 70, 2½ yd. dipper, shop No. 666.
1 Marion Shovel, Model 91, 5 yd. dipper, shop No. 1165.
1 95 ton Bucyrus Shovel with 3½ yd. dipper, used only a few months, bargain.

TRENCH MACHINES.

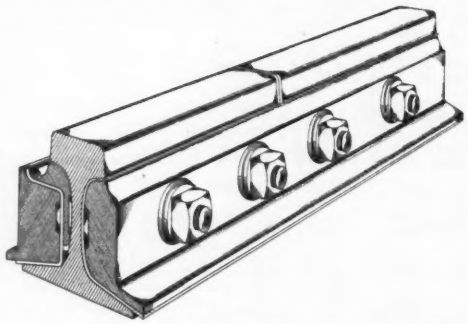
1 Parson's Trench Machine, dig 27" to 60" wide to 20' deep.
1 10'x26" Buckeye Trench Machine with extra 10"x32" wheel and caterpillar attachment.
1 Standard Carson Sewer Machine.

Prices and full description on request. Write us for any equipment you require. Prices always the cheapest, quality always the best.

If You Don't Find What You Want Here Write Us.
We Have a Lot More.

MARSH COMPANY OLD COLONY BUILDING **CHICAGO**

The KEYSTONE
Insulated RAIL JOINT



One of the most important elements in a track circuit is the insulated joint. An efficient joint should hold the track in surface and alignment and must keep down current leakage.

The ideal insulated joint would be everlasting. Most insulated joints are far from this. THE KEYSTONE JOINT is the nearest approach to the ideal yet produced. All its parts except the fibre insulation are of rolled steel. It is stronger than the non-insulated joint. Its absolute rigidity enhances the life of the fibre and keeps down maintenance cost. The construction of the joint provides for a maximum amount of bearing on the insulation per square inch with a minimum amount of pressure.

THE KEYSTONE JOINT maintains its proper spacing between rail ends allowing the non-insulated joints to open uniformly when rails contract, avoiding the wide openings so common at insulated joints during cold weather.

The service these joints are giving is demonstrating daily that the KEYSTONE is the cheapest and most efficient joint on the market considering performance as well as price.

STANDARD ON A NUMBER OF LEADING RAILROADS WHO WERE CONVINCED BY SATISFACTORY RESULTS.

TRADE MARK **The Union Switch & Signal Company** TRADE MARK

GENERAL OFFICE AND WORKS: SWISSVALE, PA.

Sales Department: Hudson Terminal Bldg., 30 Church St., New York

DISTRICT OFFICES:

Hudson Terminal Bldg. New York | Peoples Gas Bldg. Chicago | Pacific Bldg. San Francisco | Candler Annex Atlanta

FOSTER
Interlocking Switch Stand

You make a careful inspection of switches to see that they hold the points up to the rail. The Foster Interlocking Switch Stand guarantees the points to be up to the rail and secured with two separate connections from the points to the ties. The lever will not enter the latch until the point is up to the rail and bolt locked. If there is lost motion in the connections or an obstruction between the point and the rail the lever cannot be forced down into the latch. With this stand the points must be kept adjusted within safe limits to be able to operate the stand.

Any track device which is not operated by experienced men must be simple and positive. One throw of one lever parallel with the track performs all operations with the Foster Interlocking Switch Stand. This stand guarantees safe switches between times of inspections and is easy and simple to operate. It provides additional safety and does not complicate the operation of your switches. Your inspection is to see that the switches are in good order and this stand is made to keep them in good order.

One throw of ONE LEVER operates Switch, Interlock, Signals.

Foster Interlocking Switch Stands have been tested in service and do all that is claimed for them.

Frank M. Foster

515 W. First Ave., Columbus, Ohio

The American Railway Signal Co.

Something New

Single Track Automatic Blocking showing signals AUTOMATICALLY protecting opposing trains between sidings as installed by

The American Railway Signal Company.

CLEVELAND, O

- U·S·A -

THE

Official Weekly News Bulletin

is published to furnish the latest buying and selling news to advertisers in

The Monthly Official Railway List

This service is absolutely free to advertisers in the "Red" list, and we call attention to the fact that this weekly bulletin is the only one published and furnished by a monthly publication in the railway field.

If you care to have this bulletin reach your desk each week, let us hear from you.

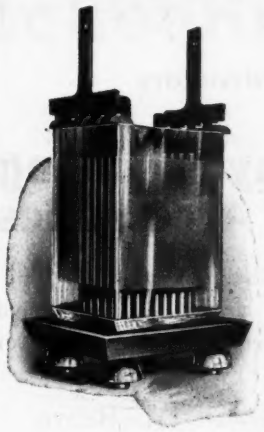
THE RAILWAY LIST COMPANY

431 South Dearborn Street, Chicago

Alphabetical Index to Advertisers

Acme Engineering & Equipment Co....17
American Railway Signal Co....1, 49
American Valve & Meter Co....9
American Water Softener Co....15
Atlas Preservative Co....7
Atlas Railway Supply Co....2
Belle Isle Motor Co....30
Booth, L. M. Co....6
Boss Nut Co....12
Bowser, S. F., & Co....14
Brown Hoisting Mach. Co....24
Bryant Zinc Co....12
Central Electric Co....1
Chicago Pneumatic Tool Co....13
Cincinnati Frog & Switch Co....6
Clark, Myron C., Pub. Co....41
Coes Wrench Co....11, 20, 21
Coffman, W. H....8
Concrete Form & Engine Co....30
Dilworth, Porter & Co....54
Dixon, Jos., Crucible Co....19
Duluth Corrugating & Roofing Co....45
Electric Railway Equipment Co....24
Enright-Frey Equipment Co....43
Fairmont Machine Co....11
Foster, F. M....48
Franklin Mfg. Co....1
Frog, Switch & Mfg. Co....16, 19
Glidden Varnish Co....1
Graver, Wm., Tank Works....23
Gray, Peter, & Sons....14
Hart Steel Co....1, 42
Hubbard & Co....1, 25
Hurley Track Laying Mach. Co....26
Indianapolis Switch & Frog Co....28, 54
Industrial Supply & Equip. Co....14, 34
Interlocking Nut & Bolt Co....19
Johnson Wrecking Frog Co....10, 40
Kalamazoo Railway Supply Co....31
Lederer, F. J., Co....51
Light Inspection Car Co....24
Lord, Geo. W....10
Lucius Engineering Co....22
Lutz Lockwood Co....3
Mamolith Carbon Paint Co....8
Manhattan Railway Supply Co....10
Manufacturers Exhibit of Ry. Supplies....38
Marsh Co....35, 47
Mecnanical Mfg. Co....19
Michigan Pipe Co....9
Milburn, Alexander, Co....6
Moore Mica Paint Co....6
Mudge, Burton W., & Co....11
Nachod Signal Co....12
Nichols, Geo. P., & Bro....14
North Western Construction Co....39
Okonite Co....1
Pendleton & Co....10
Philadelphia Turntable Co....26
Pittsburgh Filter Mfg. Co....30
Rail Joint Co., The....26
Ramapo Iron Works....9
Wm. Robertson & Co....44
Sellers Manufacturing Co....18
Seelig, R., & Son....14
Southern Railway Supply Co....37
Swift, Geo. B., Co....2
U. S. Light & Heating Co....51
Union Switch & Signal Co....48
Universal Concrete Tie Co....44
United Electric Apparatus Co....52
Vaughn Rail Support Co....26
Verona Tool Works Co....5
Waterbury Battery Co....53
Weir Frog Co....1, 5
Williams, G. H., Co....32, 33, 35
Winans Improved Rail Joint Co....27
Horace L. Winslow Co....29
Wyoming Shovel Works....14

For Signal Service Employing Storage Batteries



the high grade

"National"

Storage Battery

deserves your consideration. This Battery is thoroughly well made and we believe that due to its high efficiency and economy it "can't be beat" for all round satisfactory operation.

Our large variety of types and the elasticity of our design permits us to meet any service requirements.

The United States Light and Heating Company

General Offices: 30 Church St., New York, N. Y.

FACTORY: NIAGARA FALLS, NEW YORK

SALES OFFICES AND DEPOTS

New York Boston Buffalo Cleveland Detroit Chicago St. Louis

Style L 170

USE THE

BUFFALO AIR BRUSH

to decrease expense in your painting department by spraying your lacquers, bronzes, enamels, varnishes, japans, etc., and for painting iron fences, buildings, bridges, etc. We manufacture, hoods, spindles, lathes, filters, for use in connection with our air brushes.

A postal telling us what you paint will bring this information gratis.

F. J. LEDERER COMPANY

MANUFACTURERS AND PATENTEES

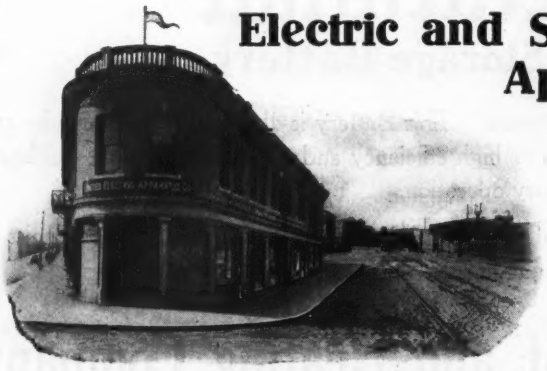
67-69-71-73 Forest Ave., BUFFALO, N. Y.

ALSO MANUFACTURERS OF THE "PEERLESS" EXHAUST FANS AND BLOWERS

United Electric Apparatus Co. Inc.

A. A. ZIEGLER, General Manager :: Est. 1880

Engineers, Manufacturers, Designers and Contractors



Electric and Steam Railway Signaling Apparatus and Accessories

Sole authorized manufacturers of the PAT and PAT. applied for line of perfected united contact and interchangeable apparatus of modern types.

Originators of all Bracket Type Relays.

Several patents pending. There are imitators.

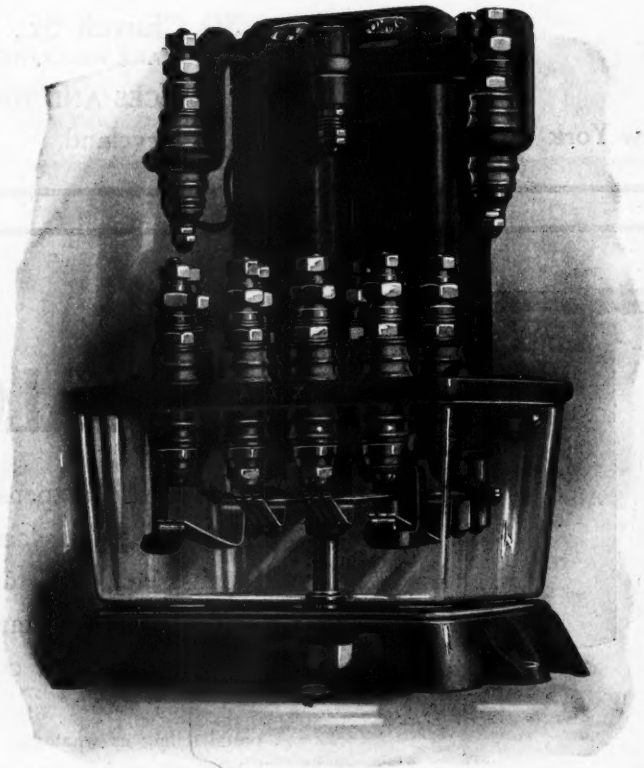
Beware of Infringers.

Our apparatus meets all the requirements of the Railway Signal Association.

We manufacture for D. C. and A. C. All forms open and enclosed track and line relays, keys, switches, repeaters, indicators, annunciators, lightning arresters, crossing, tower and call bells, and a general line of accessories and supplies.

Repairing Promptly Executed

Special Apparatus Built to Order



Type C-D.C Relay

The Signal Accessories Co.

Sole Sale Representative

140 NASSAU STREET, NEW YORK

Main Office and Factory, 1529-1533 Columbus Ave., Boston, Mass.

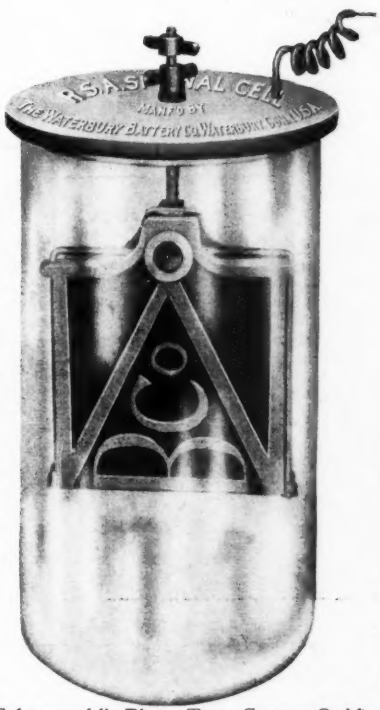
Schoenmehl's R. S. A. Cell

A *Signal* *Success*

"What you can get out of a primary cell depends upon what goes into it."

The Schoenmehl Plate Type Copper Oxide Cell is the highest development of primary batteries for signal work. It is the crystallization of years of experience—the finishing touch on a long record of success in filling the needs of signaling service.

This cell is made of the best possible materials, in a factory equipped to conduct each operation with the most minute attention to details, and the certainty that each part in design and manufacture is as good as can possibly be made. Every part is built up under the hands of master craftsmen, with the carefulness which is so indispensable to the securing of efficiency, but which can be obtained only after years of experience.



Schoenmehl's Plate Type Copper Oxide Cell, Equipped as per R. S. A. Standards, Heat Resisting Glass Jar.

Thus, there goes into the construction of the Schoenmehl cell:

1. **The best materials than can be secured.**
2. **The knowledge, acquired by many years of experience, of how to make a battery.**
3. **The inspiration of a long record of success in filling signaling requirements.**

The logical conclusion, therefore, is that what you get out of the Schoenmehl cell will be entirely in keeping.

And so it is. This conclusion is supported by service records. Why not prove it to your own satisfaction? Install some Schoenmehl batteries and let them show what they can do.

There is a clean saving from the very start; you will reduce maintenance costs to the minimum; and you will have the knowledge when using this type of cell that you have taken the very best step possible to secure efficiency in the operation of your signals.

Every cell is guaranteed for full 400 ampere hours. We have put them in. You can get them out.

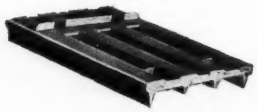
The Waterbury Battery Company

WATERBURY, CONN.

DILWORTH, PORTER AND CO., Ltd.
PITTSBURGH, PA.

TIE PLATES AND SPIKES

GOLDIE PLATE

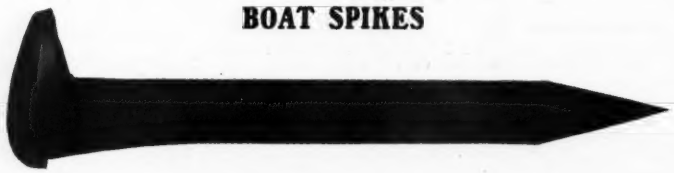


DILWORTH FLANGE PLATE

HARRIMAN PLATE

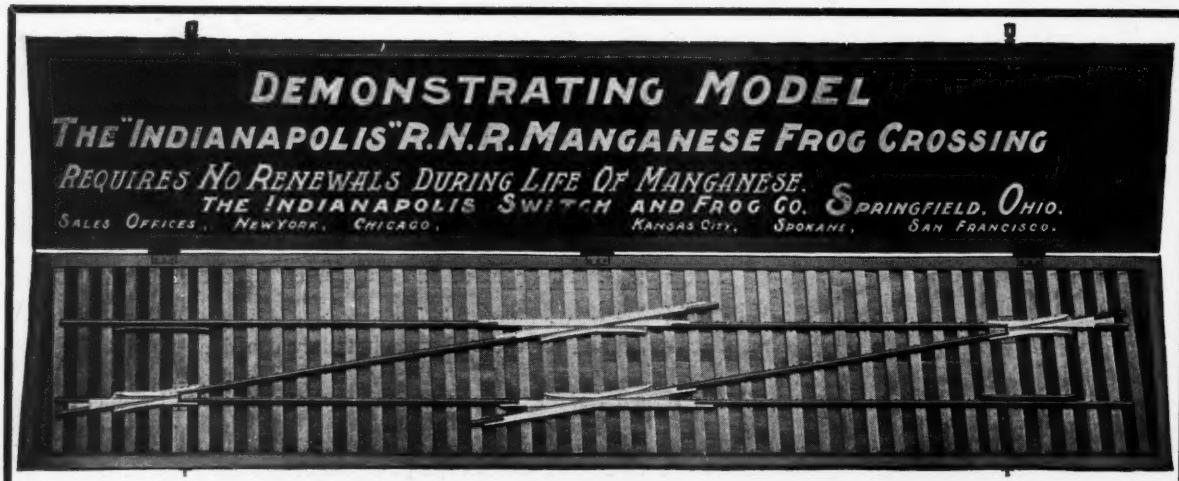
BOAT SPIKES

Standard and Special Railroad Spikes



Goldie Perfect Spikes a Specialty

Send for new catalogue


DEMONSTRATING MODEL
THE "INDIANAPOLIS" R.N.R. MANGANESE FROG CROSSING
REQUIRES NO RENEWALS DURING LIFE OF MANGANESE.
THE INDIANAPOLIS SWITCH AND FROG CO. SPRINGFIELD, OHIO.
SALES OFFICES, NEW YORK, CHICAGO, KANSAS CITY, SPOKANE, SAN FRANCISCO.